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Scientific Worthies

XLVIII. Sir Frederick Gowland Hopkins, O.M., F.R.S.

IF we consider the development of organic chemistry from its early beginnings to the present day, we may come to the conclusion that progress has in some measure taken place in a circle. In the early days the substances offered by Nature and occurring in the metabolism of plants and animals were the objects of investigation, and the isolation, purification and analysis of such substances have added lustre to the names of many chemists. Interest in the chemical elucidation of 'natural products' did not indeed decline during the past century (we need only mention the investigations of Emil Fischer on the purines, carbohydrates and proteins), but relatively this work absorbed less energy and yielded fewer results in comparison with the great problems of structural chemistry and the classification of organic compounds based thereon.

The building of the edifice of organic chemistry in the second half of the nineteenth century was an experimental achievement almost unequalled. Although important theoretical and practical problems still remain to be solved by organic chemistry, we can, nevertheless, recognize that since the beginning of the present century many leading representatives of the discipline are desirous of applying the experience and systematic knowledge already gained to a still more important problem, the elucidation of vital processes.

The trickle which a hundred years ago supplied the stimulus for the chemical investigation of animals and plants, has swollen to a mighty stream, and in the same measure the methods and the experimental resources of the modern chemist have multiplied. Whilst round about the year 1820 only two or three dozen organic compounds were known (naturally those which are most abundant and most easily isolated), there is to-day an ordered system among the very diverse materials which build up the plant and the animal, and the individual substances composing them have been separated. The perfection of micro-methods, both preparative and analytical, has enabled the investigator to enter a field previously inaccessible, to tackle substances which previously eluded him on account of their minute concentration. At the same time, the application of the resources of classical organic chemistry has made possible the synthesis of highly complicated natural products; the importance of this work is obvious when compared with the first 'bio-synthesis', of urea, more than a hundred years ago.

We should, however, clearly grasp that the development of organic chemistry during the present century, thus briefly indicated, is only preliminary to the investigation of the chemical reactions which take place in the living cell. Yet for the study of these reactions such a preliminary was quite indispensable. Without accurate chemical knowledge of all the substances taking part in metabolism, the greatest problem of biological research, the elucidation of vital processes, entirely lacks foundation. We have only to imagine how far the study of the biological degradation of polysaccharides would have proceeded without the most complete knowledge of the constitution and configuration of the substances formed in this process.

The analytical branch of biochemical research is itself only a subsidiary science, albeit very important and indeed indispensable, yet ancillary to that discipline which for purposes of classification

should be separated off as physiological chemistry or dynamic biochemistry. The methods of the analytical branch are essentially the same as those of the pure organic chemistry, and hence it does not seem expedient, for example, to describe as a biochemist one who is engaged in the elucidation of the constitution of an alkaloid or of a vegetable colouring matter. His work differs neither in nature nor in purpose from that of a chemist who aims at explaining the constitution of a constituent of coal tar or of some condensation product produced *in vitro*.

The elementary chemical foundations of the physiology of nutrition were the first to be laid down. The three chief divisions of food materials —the carbohydrates, the fats and the proteins— were already fairly well known, when in the last quarter of the nineteenth century the processes of digestion were studied and when, especially with the aid of the heats of combustion, the energy balance of warm-blooded animals could be drawn up. The physiological problem of nutrition seemed to have been solved. The administration of the requisite number of calories, calculated from the total metabolism and supplied in the form of the three main groups, with due regard to the protein requirements indicated by the nitrogen metabolism, was thought to be the practical solution of the problem, verifiable by animal experiment. This was a time when restaurants in many countries listed on their bills of fare the calorie value of the dishes supplied to their patrons.

It was about this time that Frederick Gowland Hopkins entered the scientific arena. Born in 1861, he did not take up the study of medicine until rather late—at twenty-seven years of age. Chemistry he had taught himself, and it is indicative of his leaning towards this subject that one of his first scientific investigations was devoted to a quite difficult chemical problem, that of the white wing-pigments of butterflies (Pieridæ). Among other leading results of his purely chemical work the isolation of tryptophane and of glutathione deserve special mention. They show at the same time where the centre of Hopkins' biochemical interests lies, namely, in protein.

Hopkins' most important achievement, which led to the discovery of the vitamins, developed from that phase of nutritional physiology which was briefly indicated above. He was the first to show that carbohydrate, fat, protein and inorganic salts, even when supplied in adequate amounts, do not suffice to maintain metabolic equilibrium. His experiments, planned on an extensive scale, were the first to be carried out with rats as experimental animals, and showed that other substances besides the above categories must be present in the food; these, the accessory food factors, were later named vitamins as the result of a less happy suggestion by C. Funk.

It may be worth while to consider more closely this second period of nutritional physiology. There is scarcely a great scientific discovery which has emerged suddenly, without portent, from the brain of the investigator, as did Athene from the head of Zeus. As a rule, we become aware of forebodings, felt here or there, indications and observations, which create the atmosphere for the great discovery. That man does not live by bread alone— we may slightly vary the Biblical phrase—was already indicated more than fifty years ago (1881) by work from the Basle Physiological Institute. Lundin, a pupil of Gustav Bunge, was the first to show that mice could not be kept alive on a diet which had been compounded from the previously isolated constituents of milk, that is, from its carbohydrates, fats, proteins and inorganic salts. This important observation, which was confirmed ten years later by Socin, also working in Bunge's institute, was not followed by further research in the same direction. Impressed by the nutritional importance of inorganic salts, investigators were inclined to attribute the observed deficiency phenomena to a disturbance of the combination between these salts and the organic material, as a result of working up the milk.

In his Nobel Lecture, Hopkins acknowledges the merit of the Dutch physiologist Pekelharing in having attributed the nutritional insufficiency of the milk, thus separated into its main constituents, to the absence of unknown substances present also in other food materials; thus the vitamin concept was first clearly expressed. Pekelharing's paper, published in a somewhat inaccessible journal, only became known after vitamin research had already become extensive. The most important foundation for the development of such research was laid by the well-known work of Christian Eijkman on the causation of beriberi disease (1903). It was somewhere about this time that Hopkins began his investigations of the vitamin problem, investigations planned on an ample scale and based on clear theoretical conceptions. The great advance which they brought consisted in an experimental proof of the main idea, that the deficient nutrition resulting

from the administration of the necessary calories, proteins and salts in the form of a 'synthetic' diet, is caused by the absence of factors necessary for life. Thus the concept of accessory nutritional factors was formulated by Hopkins, and so the vitamins became recognized as a new and indispensable group of foodstuffs.

Although Hopkins did not himself isolate any of the vitamins, of which he studied the effects—chiefly A and B—we are yet fully justified in regarding him as the spiritual father of vitamin chemistry. It was only by his clear physiological characterization of this group of substances that the field was prepared for the intervention of the analytical biochemist, to whom we now owe so extensive a knowledge of the vitamins hitherto isolated, knowledge gained in a remarkably short time. Closely connected with the study of the deficiency diseases due to the lack of vitamins, there are a number of similar investigations on the need for individual amino-acids formed in the hydrolysis of proteins. These researches Hopkins carried out by means of the same experimental methods; it might be said that they were ushered in by that chemical showpiece, the isolation and purification of tryptophane by means of its mercury compound. How important it is to have absolutely pure substances for physiological experiments is shown by the history of the discovery of vitamin D, which for a long time was identified as irradiated cholesterol, until Windaus and Rosenheim recognized that ergosterol was also present in apparently pure cholesterol preparations.

The work of P. Löwi and E. Abderhalden had shown that the mixture of amino-acids represented by artificially digested protein is just as suitable for nutrition as protein itself. By chemical methods it is possible to remove from the mixture one or other amino-acid, and Hopkins utilized this possibility to test the nutritional importance of individual constituents, by administering to animals the residue (together with non-nitrogenous foodstuffs) remaining in each case after removal of the amino-acid to be tested. The absence of the aliphatic amino-acids such as alanine, leucine and glutamic acid, does not adversely affect growth. If, however, tryptophane, or cystine, or histidine, or arginine has been removed from the mixture, a sharp decline in the weight of the animal is observed. These experiments give some idea of the synthetic powers of the mammalian organism, which is evidently able to build up the simple amino acids, but fails in respect of the heterocylic. It has been suggested that histidine and arginine can replace one another mutually, and in that case the cell would be able to change arginine into histidine, a process which is not yet susceptible of chemical explanation. Likewise we have no understanding of the mechanism of the conversion of these amino-acids into nucleo-purines, which Hopkins' experiments rendered extremely probable.

Notwithstanding his preference for the biochemistry of protein and of other nitrogenous metabolites of the cell, Hopkins some thirty years ago made a singularly successful excursion into the field of carbohydrates. In conjunction with Walter Fletcher, he carried out a careful quantitative study of the formation of lactic acid in muscle. Conditions were discovered under which lactic acid is formed and again disappears; thus a solid foundation was laid for later and very successful work by others in this important field.

A few years after the end of the Great War, a generous benefaction enabled Hopkins to build a modern research institute at Cambridge, where he had occupied a chair of biochemistry since 1914. The group of workers who were collected here under his leadership developed in the course of a few years into a most successful centre of biochemical research, into a *universitas* of the discipline. A large number of young investigators—some with medical, some with chemical training, foreigners as well as natives—are at work there, almost exclusively in the field which we have described above as dynamic biochemistry. Many striving young biochemists, from all over the world, have sought instruction and stimulus in this important centre of research.

The close connexion between the investigation of vital processes and the analytical branch of biochemistry may be illustrated by reference to two natural products, both discovered at Cambridge, namely *glutathione* and *cytochrome*. The isolation of glutathione by Hopkins, a brilliant chemical achievement, brought in its train a very full programme of work in physiological chemistry, which occupied the Institute for several years. The history of the discovery of this tripeptide, composed of cysteine, glutamic acid and glycine, is characteristic. At first it was regarded as the dipeptide glutaminyl cysteine, until after a few years it was recognized that, by the original method of isolation, the glycine component was lost. A more delicate method of isolation then furnished the native product, which is actually present in most cells. Glutathione combines in its

mode of reaction the role of hydrogen acceptor with that of hydrogen donator according to the scheme

$$2\ \mathrm{Gl{-}SH} \underset{+2H}{\overset{-2H}{\rightleftharpoons}} \mathrm{Gl{-}S.S{-}Gl},$$

and is probably able, in consequence of this reversible function, to act as an intermediary in the chain of biochemical dehydrogenation processes. It is certain that it functions as an activator of animal proteases and of the enzyme methyl glyoxalase. Here there is doubtless a catalytic transference of hydrogen, in which process glutathione is probably concerned according to the equation :

$$\mathrm{CH_3.CO.CH(OH)_2} + \mathrm{Gl.S.S.Gl} \rightarrow \mathrm{CH_3.CO.CO_2H} + 2\mathrm{Gl.SH}$$

hydrate form of methyl glyoxal → $\mathrm{CH_3.CHOH.COOH}$ + GlS.SGl

Cytochrome is even much more closely concerned with the transference of hydrogen in intracellular oxidative processes.

During the last fifteen years or thereabouts, research in the Institute under Hopkins' direction has been centred on vital oxidation processes. The purification of the dehydrogenating enzyme of milk (Schardinger's enzyme) and a study of its mode of action have occupied much attention. An important result has been the demonstration (by Dixon) that in the aerobic degradation of hypoxanthine and xanthine to uric acid by this enzyme, hydrogen peroxide is formed. Whilst on one hand the intermediate occurrence of hydrogen peroxide in cellular metabolism was thereby rendered probable, it was shown on the other (by Elliott) that peroxidative ferments also occur in the cell.

The principle of the hydrogen shift (dismutation), which governs the mechanism of alcoholic fermentation, has been carefully studied, especially in the metabolism of bacteria and other micro-organisms (by Quastel). The significance of intermolecular hydrogen transport in relation to the oxidative degradation of food material has already been mentioned in connexion with glutathione. The Institute at Cambridge has taken a prominent part in the modern development of the theory of vital oxidation, according to which hydrogen, the principal fuel of the cell, becomes combined with oxygen *via* several intermediate stages, not unlike a mountain torrent which finds its level over several waterfalls. The importance of this regulatory mechanism had already been pointed out by Hopkins in 1926 in his lecture to the International Physiological Congress at Stockholm.

The most important experimental result in this field was furnished by the work on cytochrome, which shows that this colouring matter, related to hæmin, possesses in its C-component the capacity to combine with the hydrogen of succinic and lactic acids when this hydrogen is activated by a specific dehydrogenase ; then, again under the influence of an enzyme, the hydrogen is given up to molecular oxygen (Keilin, Green).

Succinic acid is dehydrogenated in this way to fumaric acid. With fumaric acid as hydrogen acceptor, *Bacterium coli* is liable to 'burn' *d*-glucose anærobically, as rapidly as in the presence of molecular oxygen (Krebs). Since the great power of fumarates (and, according to Krebs, also of pyruvates) to transfer hydrogen has also been demonstrated in animal tissues (Szent-Györgyi), we have already some insight into the chemical possibilities and the devious ways open to hydrogen when activated by enzymes either ærobically or anærobically.

Further light has been thrown on the biochemistry of hydrogen by the careful study of micro-organisms capable of using the element itself for purposes of hydrogenation or for the formation of water. These organisms may be contrasted with those which eliminate molecular hydrogen (Stephenson, Stickland). A particularly interesting example of this elimination, caused by the hitherto unknown enzyme hydrogenlyase, results in a novel transformation of amino-acids. Thus, for example, the hydrogen activated in the dehydrogenation of alanine is capable of splitting glycine into acetic acid and ammonia, according to the equation :

$$\mathrm{HO_2C.CH_2.NH_2} + \mathrm{HC(CH_3).CO_2H.NH_2} \rightarrow \mathrm{HO_2C.CH_3} + \mathrm{C(CH_3).CO_2H.NH} + \mathrm{NH_3}$$

$$\mathrm{C(CH_3).CO_2H.NH} \xrightarrow{H_2O} \mathrm{OC(CH_3).CO_2H} + \mathrm{NH_3}$$

There is scarcely a section of physiological chemistry which during the last fifteen years has not engaged the attention of the Cambridge Institute under Hopkins' direction. The output of papers, revealing the influence of the master in all directions, amounts to more than six hundred. In them we find vitamin studies continued in the direction of nutritional physiology, fundamental work on general, and especially on embryonic metabolism (Needham), and also papers on the virus problem (Pirie), to mention but a few of the principal topics.

This exemplary organization of research, which has brought the Cambridge School into the van of biochemical progress, has had a powerful influence on the development of the subject in all countries in which it is studied. In addition, the personal efforts of the leader, who on many occasions has insisted on the claims of biochemical studies and has pleaded for their intensive prosecution, have had an enduring effect on the status of the discipline. H. WIELAND.

The Naming of Plants

The "Critica Botanica" of Linnæus

Translated by the late Sir Arthur Hort. Revised by Miss M. L. Green. (Ray Society Series, No. 124.) Pp. xxvii+239. (London: Bernard Quaritch, Ltd., 1938.) 12*s*. 6*d*.

THE publication of Sir Arthur Hort's scholarly translation of Linnæus's "Critica Botanica" is not only a very useful contribution to botanical science but also its appearance at the present time is singularly appropriate, since two hundred years have just elapsed since the Latin original was published in Leyden in 1737.

The late Sir Arthur Hort's manuscript was handed by Lady Hort to Sir Arthur Hill, who warmly recommended it to the Ray Society for publication, after it had been carefully checked and collated with the Latin text by Miss M. L. Green. She also translated the dedication to Dillenius, Sherardian professor of botany in the University of Oxford, for whom Linnæus entertained the highest esteem. Indeed he attributes to Dillenius some of the stimulus which encouraged him to undertake the task. "It was you", he says, "who, accustomed to weighing everything in the scales of sane reason and principle, opened to me the path, which albeit with hesitant steps I now seek to tread." Needless to say, there is no hesitancy to be found in the vigorous language in which Linnæus deals with the difficulties, which botanists were encountering at the time, owing to the absence of any rules governing the naming of plants.

In the "Critica Botanica", as the title-page indicates, the author examines the names of plants, generic, specific and varietal, retaining the better ones and rejecting the unworthy. This book forms part 4 of the "Fundamenta Botanica", which was published in the preceding year and constitutes the principles of botanical nomenclature. It is indeed the precursor of our modern international rules, which are discussed and amended at the successive International Congresses of Botany. That may suggest that the "Critica Botanica" will be dull reading. But this is far from being the case. Those interested in the history of botany will be delighted to find that it contains Linnæus's personal estimate of his botanical contemporaries and predecessors. The "Critica" may be usefully recommended to all students of botany and more particularly to those interested in systematic botany, as it will impress upon them the need there was in Linnæus's time for the adoption of the binomial nomenclature of plants, which he introduced and here defends. He also lays down the rules which should govern the choice of generic and specific names. But he is by no means dogmatic. "I submit the rules", he says, "which I have laid down for myself and in accordance with which I intend to walk. If they seem to you worthy, let them be used by you also; if not please propound something better."

In the first part of the volume, Linnæus deals with generic names, indicating those which he considers suitable for retention and those which should be rejected. Among these he includes particularly the hybrid words compounded from Greek and Latin roots, and he expresses his strong dislike of those formed by adding the suffix -oides to an existing generic name. He prefers those which have a Greek root and is antipathetic to compound words, though he is prepared to retain some like *Sempervivum* and *Saxifraga*. He rejects as generic names those of saints and miscellaneous public characters but retains those taken from mythology and the consecrated names of kings. He has a particularly soft spot for the names given to preserve the memory of botanists who have deserved well of science. After describing how kings and emperors and many brave and gallant men have wished their names to be handed down to posterity, he adds:

"Why should it not be the same with botanists, whose venture has been quite as daring? What toils, what science would be more wearisome and painful than botany, did not some singular spell of desire, which I myself cannot define, often hurry us into this pursuit. Good God! When I observe the fate of botanists, upon my word, I doubt whether to call them sane or mad in their devotion to plants. I will adduce some instances."

Then he gives particulars of his own journeys and privations and those of other well-known botanists.

In this way, the lists of generic names and his critical remarks on the same are interspersed with entertaining passages and good-humoured remarks

about botanists and would-be botanists. Thus our perusal of the "Critica" reveals Linnæus not only as the constructive systematist but we also get a glimpse of the man himself, with that twinkle in his eye which his portraits reproduce.

The second part of the volume dealing with the specific names of plants is equally interesting. The specific name, according to Linnæus, should sum up in one word the chief diagnostic character of the species and should not be descriptive of the locality in which the plant is found nor embody the name of the discoverer. Still less should it consist of a trope or metaphor such as melancholy or humble. But it is essential to read through this part of the book to realize how many specific names are really inappropriate. We also gain an insight into the methodical simplification introduced by Linnæus in comparison with the string of adjectives used by many of his predecessors in naming plants.

We close the book with feelings of respect and gratitude touched with affection for the author, with profound thanks to the translator and with due appreciation of the labours of all those who have lent their assistance to the production of this volume.

From Science to Fantasy

Horizons of Immortality: a Quest for Reality. By Erik Palmstierna. Pp. viii+366. (London: Constable and Co., Ltd., 1937.) 10*s.* net.

TO those who view with some disquietude the changing attitude of the modern temper with regard to science, this book will come with no surprise. It would seem that there is an increasing tendency among the public to demand of science what it never sets out to give, and then to blame it for giving stones where bread is craved. The aim of the scientific worker is not to provide consolation and spiritual certainty for distressed souls: it is to try to enlarge the extent of human experience and to bring it into some kind of orderly sequence.

The general drift of human thought to-day cannot be said to be wholly or even partially satisfying to many people whose type of mental activity leads rather to artistic or mystical expression than to scientific effort. For in these days much of science itself seems unintelligible; and the paradoxes of physics and the principle of indeterminism are not helpful to those who desire absolute certainty both here and hereafter. Hence the retreat into fantasy is to be understood even if it is to be deplored.

The substance of the volume under notice consists of 'messages' spelt out by the familiar method of the glass and letters. The greater part of the material has been obtained through the instrumentality of the violinist Adila Fachiri, but the earliest messages were received by her sister, Miss Jelly d'Aránvi, and a friend.

The general purport of the messages, which claim to proceed from spirits, and as such are accepted by the author of the book, is of a kind familiar to students of automatisms, and consists of spiritual advice, information and religious teaching. What is, however, of considerable interest, showing the tendency of the flight from science, is the insistence throughout the messages on the necessity for faith, and contempt for anything savouring of curiosity and intellectual criticism. "What we object to and definitely repulse," one message reads, "is curiosity and the wish to explain everything through and with your perishable brain. It is in every case a drifting again from the Great One, ergo renewed sinnings and why, because you do not want to admit nor allow that only God knows everything", etc.

Although Baron Palmstierna and the automatists apparently accept these very unevidential messages at their face value, it would seem that they suspect that the public would like something better, and thus at the end of the book occur a few cases inserted to suggest that some form of supernormal activity is clearly to be seen. Were it not for one of these cases, that of the Schumann Concerto, popularized by the British Broadcasting Corporation, it is possible that the book would have received no more attention than any other collection of automatic scripts.

It appears that in March or April 1933 Miss Jelly d'Aránvi was receiving messages by the glass and letters when Robert Schumann professed to communicate. A posthumous work of his for the violin was mentioned and some hope was expressed that Miss d'Aránvi would find and play it. At the time, Miss d'Aránvi did not remember any such work and inquiries failed to locate it. Finally, after a number of messages insisting on the search had been received, but without revealing the location, the manuscripts were found to have been deposited in the Prussian State Library, where they were duly preserved. The facts were quite simple and there was no mystery about them, but they were treated as spiritualistic propaganda and it was asserted that a long-lost manuscript had been located by psychic means, whereas the truth was that it had been acquired by the Prussian State

Library and was preserved there along with hundreds of other manuscripts. It is true that the place of preservation may not have been generally known, but this place was never revealed by the messages, excuses always being offered when the question was asked. Now, assuming the non-psychic nature of the material, how was it that Miss Jelly d'Aránÿi's mind was directed in March or April 1933 to Schumann and his unpublished manuscripts ?

In assessing the value of automatic productions, one of the main difficulties is to discover the sources of the information given. How can we trace the association of ideas when the life of the automatists is so complicated and open to so many influences ? Very often it is clearly impossible, but in the present instance two factors may be thought to have been relevant. In February 1933 the popular cheap edition of Bedford's "Robert Schumann" was published, which was originally issued in 1925 in the "Masters of Music" series. In this work the unpublished concerto was mentioned. Now in March of the same year it was announced in Great Britain that six new Schumann polonaises had been discovered in the archives of the Vienna Gesellschaft der Musikfreunde. Further, in Moser's "Joseph Joachim", where the concerto is also mentioned, we are told that the last movement "is written as a polonaise in three-quarter time". Since Miss Jelly d'Aránÿi is related to Joachim, we may presume that at one time she may have looked at Moser's book, and the news of the discovery of the six unpublished polonaises in Vienna may have been the trigger which set the automatism in motion, or at least it may be regarded as the kind of mechanism which we should expect when searching for the origin of such subliminal activity.

Baron Palmstierna attempts to discredit the evidence for the theory of subconscious mental processes in *Bulletin* 4 of the International Institute for Psychical Research Ltd. (London, 1937), although his arguments can scarcely be called convincing. Space is lacking to discuss these, but it may be said that the author is of such transparent honesty and sincerity that efforts to shake his conviction are not likely to succeed. It is clear that a critical analysis of the messages is not desired, for in them he thinks that many would say that "we are near the State which Saints and Mystics call the Communion of Saints". Whatever we may think of the flight from science into fantasy, it is clearly satisfying to those who have undertaken it.

The Soviet Polar Station

On the Top of the World:

The Soviet Expedition to the North Pole, 1937. By L. Brontman. Edited by Academician O. J. Schmidt. Pp. 287 + 25 plates. (London: Victor Gollancz, Ltd., 1938.) 16*s.* net.

THE acclaim which greets a polar expedition is too often measured by the accidents with which it has been beset, and nothing gives greater popularity than disaster. But the Soviet expedition to the North Pole gained no fame on these grounds. It was the sheer audacity of the venture that brought it to notice. The use of aeroplanes in polar exploration was not new; many daring and successful flights had already been made in both arctic and antarctic regions. But so far no party of explorers had voluntarily submitted to living on the floating pack-ice with no obvious line of retreat. Here was no hurried journey across the sea-ice, but a stay of uncertain duration on a floe of uncertain stability and unknown destination. It was not, however, a reckless project, for certain movements of the arctic pack were known and could be anticipated, and aeroplanes and ice-breakers were all the time held in readiness for the rescue.

The book under notice gives an account of the preparations and equipment of the expedition by one of the Moscow newspaper correspondents who was present at its start in the vicinity of the Pole. The scheme was part of the widely planned exploration and development of Soviet Arctic territory, although by a touch of irony the entire course of the floe was outside the Soviet sphere. An advanced flying base was chosen on Rudolf Island, one of the Franz Josef Islands in lat. 81° 50′ N. Thither an icebreaker and another steamer carried supplies and material for a station, and when all was ready, five aeroplanes set out from Moscow and, after a relatively uneventful journey via Novaya Zemlya, reached the base on April 19. There the aeroplanes were refuelled and overhauled and after a reconnaissance flight and a wait on account of bad weather, the Pole was reached on May 26 and the work of the observatory began.

There was abundant food, carefully chosen. Clothing and tents were well designed and scientific equipment was admirable. In a few days the aeroplanes returned to Europe and left the four men to their own resources.

The book is full of detail up to this time and recounts also the return flight. Then follow some

of the wireless messages sent out for two months and there the book ends, for it was compiled too early to record the last months of precarious drift, the prospective dangers off the Greenland coast and the rescue in the depths of the Arctic winter. No striking discoveries were made or indeed expected: the Arctic has yielded its chief secrets. The thrills of flying abound in every chapter, but the speed of air transport has robbed the polar narrative of its sustained interest and tended to make it solely a record of mechanical triumph.

Beyond this, two aspects of the expedition are notable. One is the extraordinary efficiency of the organization and equipment: everything worked to plan; nothing went amiss; no life nor aeroplane was lost. The other feature is the boundless enthusiasm of all who participated in the venture. One expects polar explorers to have enthusiasm for their work, but few have so persistently recorded their feelings of enthusiasm and devotion to their national ideals. There is no criticism of plan, equipment or accomplishment: an endless song of praise and congratulation permeates the book, but there is little laughter or high spirits. The valuable scientific results receive little attention, as might be expected in a book written before the expedition had ended.

However, the new methods of polar technique which flying has introduced are well expounded, and there are useful lists of equipment, stores and instruments. Not the least interesting chapter gives the biographies of the four men. All had considerable previous polar experience and all had that longing for polar regions that once acquired is so hard to overcome. There are many excellent illustrations and two adequate maps.

R. N. RUDMOSE BROWN.

Economists Arraigned

Lament for Economics

By Barbara Wootton. Pp. 322. (London: George Allen and Unwin, Ltd., 1938.) 6s. net.

THE indictment is that "the economic theory of to-day is useless because it is unintelligible; because, after all their arduous studies, the economists cannot be relied upon not to give diametrically opposite diagnoses and prognoses of the same situation . . .; because the economists feed on their own tails by busying themselves with the analysis of imaginary worlds which they themselves have invented; and because they are passing off as the result of purely scientific inquiry what is in reality no more than a partisan advocacy of particular social policies".

The charge of unintelligibility having been dismissed, in Chapter ii the author examines "the relation of economic theory to the actual world", and the question why economic theory has not contributed more than it has to the solution of practical economic problems. The next two chapters discuss the claim of economics to be a science, and the accusation that economics is mere apologetics for contemporary institutions. Chapter v considers how far market equilibrium correctly interprets the optimum distribution of resources, and finally, in the light of all these discussions, the author puts forward her views as to the lines along which economics should be developed in the future.

It must now be stated that the writer of this review is one of "the economists" as defined by Mrs. Wootton. Having made every effort to overcome the resulting bias, I cannot persuade myself that this is a very useful book or one worthy of its author. The trouble is that it attempts to combine (1) an apologia to the man in the street on behalf of economics and "the economists", (2) an attack on "the economists" and on one economist in particular, who incidentally will probably be astounded to find himself deemed so representative of the general thought of economists to-day, and (3) proposals which, however admirable in themselves, are not exactly novel and do not seem to have much logical connexion with the preceding chapters. The result is that this book is neither a deadly attack on "the economists" nor a serious contribution to the future development of economics. Most, if not all, economists will find many pages and some conclusions with which they can heartily agree and much with which they will disagree, but they will find little of which they are not perfectly well aware. The general reader may gain a better knowledge of much of which he is imperfectly aware, but at the end his ideas as to "the economists", their aims and the sort of work they do will probably be even more curious and less exact than they are at present. Even the general lines of the proposals in the concluding chapter can be and have been argued more forcibly on very different premises.

As Mrs. Wootton knows, and in part admits, self-satisfaction is not a besetting sin of "the economists", and many fully share her troubles and sorrows. But this book seems to have been written in something very like mere exasperation, and, however pardonable, exasperation is not conducive to well-balanced and constructive thought or to enlightened vision.

J. W. F. ROWE.

Tables Annuelles Internationales de Constantes et Données numériques:
International Annual Tables of Constants and Numerical Data. Vol. 11 (Years 1931–1934.) Part 1 (Sections 1–25). Pp. xvi+492+xv–xxv. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1937.)

THESE sections contain very complete numerical data on molecular spectra of diatomic and of polyatomic molecules. In addition, the derived quantities—electronic levels, fundamental vibration frequencies, anharmonic coefficients, moments of inertia, atomic distances, linkage force constants, and dissociation energies—are presented in an accessible and systematic way, and many of the relationships explained by potential energy curves. The tables will prove invaluable to both physicists and chemists interested in the problems of molecular structure, and the simplicity of the arrangement will give confidence to those who may hesitate before attempting to seek the solution to a query in the complexities of the original literature. To the critical survey of molecular spectra is appended a bibliography and element-index of the numerous papers on atomic spectra which have appeared in the period 1931–34.

Peter Kürten:
a Study in Sadism. By George Godwin. Pp. 60. (London: The Acorn Press, 1938.) 5*s*. net.

IN "Peter Kürten", George Godwin has given us an account of one of the most horrible series of crimes in history. Peter Kürten, who was a sadist of the worst type, kept Düsseldorf in a state of terror. His record of crime went back to his childhood, when he pushed two boy friends off a raft on the river and drowned them. When tried, he was charged with ten murders and convicted of nine of them. The medico-legal experts came to the conclusion that the Düsseldorf 'monster' was suffering from no organic mental disease or from any functional mental disease, and was therefore responsible in law for his crimes.

Reading, Writing and Speech Problems in Children:
a Presentation of Certain Types of Disorders in the Development of the Language Faculty. By Prof. Samuel Torrey Orton. (Thomas W. Salmon Memorial Lectures.) Pp. 215. (London: Chapman and Hall, Ltd., 1937.) 10*s*. 6*d*. net.

THIS book contains the third of the Thomas W. Salmon Memorial Lectures. The writer gives an account of his well-known work on disorders of the language faculty in children. He discusses the various disorders of language found in the adult as a basis for considering the language disorders of children. The work is based on his very wide clinical experience of ten years, combined with pathological material. He also gives the results of therapeutic efforts based on this work, and shows that many children with speech defects have derived benefit. The work is a most valuable addition to our knowledge of speech defects not only in children but also in adults.

An Elementary Treatise on Statically Indeterminate Stresses
By Prof. J. I. Parcel and Prof. G. A. Maney. Second edition. Pp. xvi+432. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 25*s*. net.

THE continuous attack made during recent years on the problems of indeterminate structures and the heavy labours involved in all rational computations of such types necessitate the careful study of the scope and function of different methods, with a view to effective selection. The first edition of this book was finely characterized by a well-balanced consideration of the various methods of attack, and this second edition incorporates extensions that include the new and useful Cross method, and special adaptations of the slope deflection method. The re-written chapter on rigid frames includes a good treatment of the multi-storied building, but does not refer to the work of the British Steel Structures Research Committee. All illustrative examples are worked with great clearness, and in its scope and arrangement the book is excellently designed for the student who intends to use structural theory.

Plato's Conception of Philosophy
By Dr. H. Gauss. Pp. xxii+272. (London: Macmillan and Co., Ltd., 1937.) 6*s*. net.

THE author of this ably written book is right in considering philosophy less as a body of results than as a mode of life. Owing probably to his wish to defend this conception, he restricts his inquiry into Plato's doctrines to his attitude towards epistomology, ethics and life in general. On these points Dr. Gauss has many useful suggestions to make which may serve to complete the traditional interpretation of Plato that has become part of British philosophy. Besides the scholarly interest of this work, to which Prof. Taylor contributes a striking preface, there is an attempt to show that philosophy is not a purely academic pursuit. The success of this plea will depend in large measure on the use of the author's method for the interpretation of other aspects of philosophy and of its history.

T. G.

The Definition of Psychology:
an Introduction to Psychological Systems. By Dr. Fred S. Keller. (Century Psychology Series.) Pp. viii+111. (New York and London: D. Appleton-Century Co., Inc., 1937.) 4*s*. 6*d*. net.

THIS volume gives a very good account of the growth of the conception of psychology through the years, from the early days through the work of Titchener and up to the most recent work of the behaviourists and finally the *Gestalt* school. Psychology is becoming more objective and standing more on its own feet with less dependence on physiology. It is more genetic and comparative, and occupies itself more with individual differences, and with abnormal psychology. There is a strong flavour of behaviourism about the author's views, tinged with a respect for the *Gestalt* school.

The Concept of Species in Biology

THE one hundredth and fiftieth anniversary meeting of the Linnean Society of London took place on May 24, when the presidential address was delivered by Dr. John Ramsbottom, and on the two following days symposia were held in which a number of distinguished British and foreign zoologists and botanists took part. The meetings, which were attended by a large concourse of fellows and foreign members of the Society and by delegates from many cognate societies and institutions in Great Britain and overseas, were held in the lecture theatre of the Royal Institution and were planned to provide for a discussion of the various aspects of the 'species problem' in biology. The address of the president dealt with "Linnæus and the Species Concept" and the subjects of the two symposia were, respectively, "The Concept of Species from Linnæus to the Present Day" and "Geographical Isolation as a Factor in Species Formation".

LINNÆUS'S CONCEPT OF SPECIES

In his address, Dr. Ramsbottom pointed out that, in studying the works of Linnæus, it must not be assumed that his opinions remained unchanged throughout the whole of his career, from his first book in 1737 to his last in 1767; incidental observations must be interpreted in their relation to the particular subject under discussion; and we must guard against reading into some isolated sentence the germ of a theory formulated at a later date. The doctrine of the fixity of species, so far as it was accepted by the predecessors and contemporaries of Linnæus, was a deduction from the Mosaic account of the Creation, an account which some at least of the early Fathers of the Church did not accept as conveying scientific as distinguished from moral and spiritual truth. The doctrine was enunciated by Linnæus in an often-quoted passage in his "Philosophia Botanica" in 1751: "Of species of plants we reckon so many as there were different forms created in the beginning by the Infinite Being; and these forms, according to the appointed laws of generation, have always produced offspring like themselves."

It is clear, however, that even when this categorical statement was printed, Linnæus had some mental reservations and qualifications. He was already engaged upon his "Species Plantarum", published two years later. Scattered through this work are passages difficult to reconcile with the dogmatism of the "Philosophia". For example, under *Rosa indica* he writes: "The species of *Rosa* are difficult to distinguish and more difficult to determine; it seems to me that Nature has intermingled several or in sport formed several from one". After describing four species of *Scorpiurus* he adds, "It is beyond doubt that all these formerly arose from a single species", and of certain species of *Geranium* he says, "The flower and habit of the last three species show that at the beginning they were one". In this respect, evidently, his didactic aphorisms lagged behind his practice.

So early as 1744 Linnæus had discussed the possibility that new species of plants might arise by hybridization, and in the later years of his life he gave much attention to this subject. Dr. Ramsbottom quoted many passages on this subject. Perhaps the most striking was from a work published in 1761 where, after discussing such possibilities as that "a genus is nothing else than a number of plants sprung from the same mother by different fathers", Linnæus concludes, "But whether all these species be the offspring of time, whether in the beginning of all things the Creator limited the number of future species, I dare not presume to determine".

In the light of these and many other passages, Sachs's assertion that Linnæus "held fast to the end of his life" to the dogma of the fixity of species is simply untrue.

For a century after Linnæus, botanists and zoologists were hard at work accumulating and naming collections. The Linnæan systems of classification and nomenclature afforded, to the botanists at least, the only hope of grappling effectively with the rapidly growing masses of material. They dreaded the confusion that would result if these were interfered with. Hence the vehement opposition that was at first offered to attempts to introduce a natural system of classification; hence, also, the tradition that Linnæus was an inflexible upholder of the permanence of species.

DEVELOPMENT OF SPECIES CONCEPT

In the two symposia on May 25 and 26 a large number of speakers took part either by reading papers or in the course of the subsequent discussion.

Space does not permit of our giving more than brief summaries of a few of the papers, and the following must not be taken to represent more than the impressions of one member of the audience. A full report will appear in due course in the *Proceedings* of the Society.

The first symposium was opened by Sir Edward Poulton, who said that, in his opinion, a species must be regarded primarily as an interbreeding or syngamic community. Proof of this syngamy is often difficult to obtain and long delayed, but it is conclusive and brings release from the need for regarding the species as merely an artificial grouping for purposes of convenience. Continuity or transition of characters between two groups is held to prove that one is a variety of the other, discontinuity that they are distinct species. Discontinuity, however, is not enough, as is shown in the case of polymorphic species. The splendid collections bequeathed to the nation by the late Lord Rothschild bring into prominence the conception of sub-specific groups fused by syngamy into single species but ever ready, by preferential mating or the effects of isolation, to break up into separate species.

Prof. E. W. MacBride said that since Darwin's time it has been shown that the minute variations on which he rested his case were not inherited. Mutations, on which the whole of modern genetics depends, are characterized by a loss of viability as compared with the type, and can never have survived in the wild state. The cytological basis of genetics is unstable and some of its assumptions are demonstrably false. There remain only acquired habits, asserted by Lamarck in 1809 to be the cause of the differentiation of species, and this has now been experimentally proved.

Prof. Ö. Winge (Copenhagen) while regarding the genetic nature of specific differences as beyond discussion, said that it is often difficult to decide in any given case how many genes are involved and whether the cytoplasm, as well as the nucleus, plays a part in the inheritance of such differences. It was discussed whether the differences between species, genera, families, etc., are of a special nature, and three possibilities were considered; (1) that the taxonomically important genes are polymerically present in several or all of the chromosomes; (2) that "vital genes" (the alleles to "lethal genes") are of particular taxonomic significance; and (3) that the genes in question are stable, non-mutable, and hence escape our analysis.

Sir Arthur Smith Woodward said that our increasing knowledge of extinct animals is making the use of the Linnæan method of classification very difficult. Instead of classes, orders, families and genera, the palæontologist is concerned with phyla, lineages, branches and grades. Related lineages pass through the same orderly succession of changes, by which the same—or nearly the same—result is eventually obtained. Examples of parallel evolution and polyphyly were described in Graptolites, Elasmobranchs and Holostean fishes, and others were mentioned in reptiles, birds and mammals. Sir Arthur considers, however, that it is premature to attempt to introduce new principles for naming species, genera and families, and that it is convenient to retain the old system as a provisional expedient until we are more sure of our facts.

Dr. Karl Jordan (Tring Museum) pointed out that, although geographical variations were known at the time when the Linnean Society was founded, the fact that the area of most species is subdivided into smaller areas each populated by a subspecies is a comparatively modern discovery the significance of which is not generally grasped by biologists. The subspecies are the real units on which research in systematics is based, and he emphasized the importance for research of large collections like those in the Tring Museum brought together with this end in view.

Other speakers who took part in this symposium were Dr. E. Stensiö (Stockholm), Prof. H. J. Lam (Leyden), Prof. M. J. Sirks (Groningen), Prof. H. Boschma (Leyden), Prof. B. Němec (Prague) and Prof. W. Robyns (Brussels).

Geographical Isolation and Species Formation

The subject of the second symposium was introduced by an address by Dr. Julian Huxley, summarizing the present state of knowledge on geographical differentiation. He said that species inhabiting large but continuous areas tend to show gradations of character from one part of their range to another. For these continuous graded changes he has introduced the term "phenocline". Gaps may be produced in this continuity by obstacles to interbreeding, spatial (topographical), ecological, genetical, physiological, or psychological. Subspecies might thus be produced by segregation of non-adaptive mutations or by the beginnings of adaptive radiation.

Prof. P. A. Buxton spoke on the insect fauna of oceanic islands. He said that although the fauna and flora of such islands are impoverished it must not be assumed that competition is therefore less severe. In the absence of many predatory groups of animals the struggle for existence may be less hard and there may be more freedom of evolution. This would explain the extreme variability of some species of insects (of which examples were described) and the formation of "endemic complexes" of closely related species.

It is less easy to account for the appearance of many monotypic endemic genera.

Dr. E. Fischer-Piette (Paris) gave an account of his work on the limpets of the North Atlantic. These form a complex capable of splitting into several species. This splitting is realized, morphologically and ecologically, in certain districts of the coastline, but not in others. In these last districts there is much variation, leading to unaccustomed types each special to a locality. Geographical isolation is not necessary for the formation of new species of limpets, although their formation is greatly favoured by it.

Dr. Bernard Rensch (Münster) opposed the view put forward by Goldschmidt, among others, that the transformation of species is governed by special laws, whereas geographical races only result from a secondary splitting up of species. He considers that geographical isolation of large populations is the first step not only towards new races but also towards new species, and that such a differentiation gives rise also to the higher systematic categories. The separation of new species by isolation from race-complexes (*Rassenkreise*) is the chief method of evolution. Examples of other methods are not numerous. Sometimes ecological isolation has been at work and, more rarely, a dominant mutation arises and spreads until it replaces the original form. In other cases, selection by external factors, especially climatic ones, is evident, leading to parallelism among geographical races. Prof. Karl Skottsberg discussed the flora of the Juan Fernandez group of islands and of the Hawaiian group.

In both symposia, more especially the first, the various speakers approached the problem of the nature and origin of species from very diverse points of view—systematic, palæontological, ecological, genetic, cytological. There resulted a certain appearance of discontinuity in the discussion, which, as one of the speakers remarked, emphasized the desirability of combined and detailed exploration of the field towards which all these lines of research converge. For such exploration, no more fitting place could be found than the Linnean Society.

Molecular Migration under the Influence of Centrifugal, Osmotic and Electric Forces*

OUR knowledge of the mass movements of large molecules in various fields of force has its foundation in the early researches of Svedberg, and consists in large part in contributions from the Uppsala School. Since the occasion of Svedberg's recent lectures at Oxford†, further improvements in experimental technique have been made, and the scope of these physical investigations, particularly where they touch on biological problems, has been greatly enlarged.

Studies of the resolving power of centrifuge rotors reveal that, in general, rotors of large diameter rotating at low speeds are preferable to smaller rotors at higher speeds. The resolving power is slightly higher and greater accuracy of optical observation is possible with the larger rotors. For rotor construction, steel is still to be preferred to light metal alloys, in spite of the greater ratio of strength to density offered by the newer aircraft alloys. This is due to the fact that around the cell holes, about one half of the total stress arises from the outward thrust of the cell, and the cell weight in modern constructions is reduced to a minimum. By reducing the bearing diameter from 18 mm. to 10 mm., the power dissipated in bearing friction has been reduced to some 300 watts at 60,000 revolutions per minute, or about one seventh of the earlier value. Rotors with such low bearing friction take an inconveniently long time to come to rest, and to reduce this time a magnetic brake system has been introduced. In spite of the much lower frictional losses in the air turbine ultracentrifuge, the energy required to drive this type is now actually greater than in the case of the oil turbine machine, owing mainly to the much lower efficiency of the air turbines. A new type of divided centrifuge cell, the inner chamber of which is made from the British transparent plastic 'Perspex', is available which enables the observation and separation in substance of ultracentrifuge fractions at the end of an experiment.

The study of molecular migrations in the electric field has been facilitated by the development of an improved electrophoresis apparatus by Tiselius in Svedberg's laboratory. It is possible with this apparatus to observe the migration of the components of a mixture and to isolate these for subsequent chemical or biological investigation.

* An account of three lectures delivered by Prof. The Svedberg, of Uppsala, at University College, London, on April 29, May 2 and 3.

† Summarized in a supplement to NATURE of June 19, 1937

By application of the methods of sedimentation, osmotic and electrophoretic analysis to many naturally occurring substances, much valuable information has been obtained, and certain general conclusions may be drawn regarding the molecular state of substances in Nature. Of the proteins it may be said that Nature prefers to manufacture these in a homogeneous form, that is, with molecules all of the same size. Good examples of homogeneous proteins are the albumin of the hen's egg, the crystalline globulin of milk, and the coloured respiratory proteins. A protein is only homogeneous within certain limits of hydrogen ion concentration of its solution. Outside these limits, associations and dissociations of the molecules take place. In the case of the hæmocyanin pigment from the snail *Helix pomatia*, for example, dissociation of the large parent molecule occurs into fragments of one half, one eighth and one sixteenth of the molecular weight of the original. Numerous other factors cause similar step-wise degradation of protein molecules, the changes being often of an irreversible nature. Of special interest is a form of specific degradation which is, however, reversible. It appears that in a mixture of proteins the larger molecules are frequently split up by the influence of the smaller molecules. Blood serum affords an important illustration of this, the concentration of smaller molecules in the undiluted serum being increased markedly by dissociation of the larger globulin molecules into fragments of the approximate weight of serum albumin, namely, 69,000. It is not possible to give a complete explanation of this phenomenon, which must be of great importance in the living organism.

Proteins which are homogeneous in the centrifuge are frequently also homogeneous in the electrophoresis apparatus. A notable exception is the globulin of blood serum, the molecules of which are approximately uniform in size with a weight in the neighbourhood of 160,000. In the electric field these molecules separate into three distinct groups of different mobilities. Tiselius has been able to isolate these globulins and to characterize them as protein entities.

Various diseases alter the state of the serum proteins, and it is well known that in the majority of cases the alteration affects only the globulin part of the serum. These new methods show that in the serum obtained by immunizing the rabbit with egg albumin, only one of the three normal globulins is increased. Separation of this globulin results in a considerable concentration of specifically precipitable protein. Immunization of the rabbit with type III pneumococcus results in the appearance of a new serum protein with the same molecular weight as the normal rabbit globulins but electrochemically different from these. On absorption of the serum with the type specific carbohydrate, this new fraction can be removed quantitatively from the electrophoresis photograph. On the other hand, immunization of the horse with type I pneumococcus produces a fraction which is different both in respect of molecular weight and electrophoretic mobility from the normal globulins. These and other phenomena demonstrate that the changes in the serum proteins which accompany the development of immunity are of a diverse nature and are not at the moment amenable to any simple explanation.

In the important field of the respiratory proteins, cytochrome *C* and myoglobin have been found to have the same molecular weight, namely 17,000, or approximately one fourth of the weight of hæmoglobin. The yellow enzyme, on the other hand, has a molecular weight of 80,000 and one prosthetic group in the molecule. All the enzymes so far isolated in a pure state have been proved to be proteins. Pepsin is a well-defined protein of molecular weight 37,000. The catalase molecule has recently been shown to contain four atoms of iron in the molecule, like hæmoglobin, but to have a molecular weight approximately four times as great, namely, 248,000. The largest enzyme molecule so far measured is that of crystalline urease, which has a weight of 483,000.

In recent years, more attention has been devoted to systems containing linear macromolecules. This field includes the carbohydrates, particularly cellulose, starch and glycogen ; synthetic polymers such as the polystyrenes ; and hydrocarbons such as rubber. In general these systems are far from homogeneous, the chain length varying from one molecule to another. The main object of study, therefore, is the size-distribution curve, which is best obtained from measurements of sedimentation velocity. Suitable solvents are often difficult to find, and the interpretation of the results is complicated by the asymmetry of the molecules, by the interactions of neighbouring molecules, and by solvation. The molecular state of starch is much influenced by the past history of the preparation. Acid-treated solutions show an amylose fraction of mean molecular weight about 60,000 and an amylo pectin of approximately 200,000 ; both are polydisperse. Glycogen and its methylated derivatives are highly polymerized, and also polydisperse. The specific polysaccharide of type I pneumococcus is polydisperse with an average weight of approximately 225,000. Recently, however, a homogeneous polysaccharide of low molecular weight, namely, 9,000, has been isolated by Dr. Florence Seibert from filtrates of tubercle bacillus cultures.

A. S. McFARLANE.

News and Views

Sir D'Arcy Thompson, C.B., F.R.S.

AT the anniversary meeting of the Linnean Society held on May 24, the Linnean Gold Medal was presented to Sir D'Arcy Wentworth Thompson. In handing the medal to him, Dr. J. Ramsbottom, the president, said: "Since its foundation, the Linnean Society, while maintaining the traditions associated with the great Swedish naturalist whose name it bears, has always welcomed to its fellowship the disciples of the newer schools whose studies of the organic world have led them into fields of knowledge Linnæus never knew. It seemed to our Council, therefore, especially fitting that on this, our one hundred and fiftieth anniversary meeting, the highest honour in our gift should be conferred on a naturalist who, more than any other of our time, has shown himself to be at home in both the fields of the old and of the newer learning. The founders of our Society were, most of them, classical scholars as well as men of science, and we can well imagine Bishop Goodenough and Sir James Edward Smith exchanging snuff-boxes while they discussed and approved the ripe scholarship of your 'Glossary of Greek Birds' and your translation of Aristotle's 'Historia Animalium'. But, if these works are in the eighteenth century tradition, your 'Growth and Form' is no less distinctively in that of the twentieth. Published in war-time, it was one of the first scientific books some of us read when we came back to civil and scientific life in 1919. It is already something of a classic on the shelves of the younger biologists of the experimental school, and we turn to it again and again, not only for information but for inspiration and delight. In selecting you, sir, as the recipient of the Linnean medal, we have no doubt that our choice is one that would have pleased Linnæus himself."

Cases of the Linnæan Collections

DURING the Great War, the herbarium formed by Linnæus and now in the possession of the Linnean Society of London, was removed from the three wooden cases which had contained it since the time of Linnæus and placed for greater safety in steel cabinets. The Council of the Society recently decided that the one hundred and fiftieth anniversary of the Society would be a fitting occasion for returning two of the cases to their original home by presenting one to the Swedish Linnean Society and one to the Linnæus Museum at Hammarby. At the anniversary meeting of May 24, the keys of the cases were handed by the president to Prof. Robert Fries, president of the Swedish Linnean Society. Prof. Fries, in expressing thanks for the gift, said that all Swedish naturalists are grateful to the Linnean Society of London for the great care it has always taken of the priceless treasures in its custody.

Prof. R. H. Fowler, F.R.S.

THE Lord President of the Council has appointed Prof. R. H. Fowler to be director of the National Physical Laboratory with effect as from October 1 next, in succession to Dr. W. H. Bragg, who has been elected to the Cavendish professorship of experimental physics in the University of Cambridge. Prof. Fowler, who is now forty-nine years of age, has had a brilliant career at Cambridge. So long ago as 1914 he was elected a fellow of Trinity College, and he received the Adams Prize in 1925 for an essay on "The Physical State of Matter at High Temperature". In 1932 he was appointed to one of the John Humphrey Plummer professorships established at Cambridge in the previous year, namely, that of mathematical physics. His election to the Royal Society came in 1925, and he was awarded one of the Society's Royal Medals in 1936. Prof. Fowler's scientific work includes the development of a general theory of statistical mechanics, with applications of outstanding importance to the equilibrium of mixed crystals and to the theory of semi-conductors. His work on the photo-electric effect led to a means of determining the true threshold frequencies. He has also developed new aspects of the quantum theory of energy exchange between gases and solids. Finally, by his application of the developing quantum theory to the solution of problems under investigation by groups of experimental physicists working in close association with him at Cambridge, he has made contributions of fundamental importance to both theoretical and practical physics.

Sir Thomas Middleton, K.C.I.E., F.R.S.

THE Committee of the Privy Council for the Organization and Development of Agricultural Research, after consultation with the members of the Agricultural Research Council and the president of the Royal Society, has appointed Sir Thomas H. Middleton to be chairman of the Agricultural Research Council as from July 1. On that date the Right Hon. Lord Richard Cavendish, who has been chairman of the Council since its inception in June 1931, retires from membership of the Council. Sir Thomas Middleton, who is vice-chairman of the Development Commission, an office which he has held since 1929, has been a member of the Agricultural Research Council since its establishment. He is chairman of one Standing Committee of the Council on Soils and Plant Nutrition and of the Committee on the Estimates of Research Institutions. Sir Thomas has been successively professor of agriculture in Baroda College, India, lecturer in agriculture in the University College of Wales, Aberystwyth, professor of agriculture in Durham College of Science, and professor of agriculture at Cambridge. In 1906 he joined the staff of the Board of Agriculture and

Fisheries as assistant secretary, and in 1917–19 was deputy director-general of the Food Production Department. He was a member of the Royal Commission on Agriculture in India, which sat in 1926–28. He was the first recipient of the Gold Medal of the Royal Agricultural Society of England, awarded for services to agriculture.

A Tribute to Sir John McFadyean

IT was a happy thought that prompted some of his colleagues to obtain Sir John McFadyean's consent to allow them to design and edit the December (1937) number of the *Journal of Comparative Pathology and Therapeutics* as a jubilee number and *Festschrift*. This number forms the conclusion of the fiftieth volume of the journal, which was founded by Sir John McFadyean in 1888, and has since been edited by him almost entirely single-handed, and this unique occasion has been utilized to issue this number as a *Festschrift* in honour of Sir John's outstanding contributions to veterinary science during his long career. These have been mainly confined to problems concerning the control of tuberculosis, contagious abortion and glanders among farm animals, the etiology and occurrence of Johne's disease in Great Britain, and the discovery that the virus of horse sickness is a filterable one. The esteem in which Sir John is held is manifest from the contributions contained in this number, which come from all parts of the world. Appreciations of the man and his work are contributed by many, including Sir John Kelland of the Ministry of Agriculture and Fisheries; Sir Robert Muir; Sir John Ledingham; Prof. von Ostertag, Tübingen; Dr. Schmaltz, Berlin; Prof. Leclainche, Paris; Dr. Mohler, United States; and Dr. Hilton, Canada. Several excellent portraits of Sir John are reproduced.

Dr. H. J. Gough, M.B.E., F.R.S.

DR. H. J. GOUGH, superintendent of the Engineering Department of the National Physical Laboratory, has been appointed to the new post of director of scientific research at the War Office. Dr. Gough will be directly responsible to the director-general of munitions production for the general direction and organization of research work for War Office purposes; for advising as to the programme of research work to be undertaken and as to proposals for specific investigations; and for the efficiency of the organization for research and experimental purposes of the various research organizations under the War Office. He will represent that Department on the various interdepartmental research organizations.

Tercentenary of Two French Botanists

THE year 1638 saw the birth of two notable French botanists, Guy-Crescent Fagon, who was born in Paris on May 11, 1638, and Pierre Magnol, who was born at Montpellier on June 8, 1638. Both were physicians, both were connected with botanical gardens and both were members of the Paris Academy of Sciences. Fagon was a nephew of Guy de la Brosse (died 1641) who first suggested and eventually, in 1626, laid out the "Jardin Royal de herbes médicinales" in Paris, the site of which was a piece of waste ground where the refuse of centuries had collected. It is now the Jardin des Plantes. After taking his degree in medicine in 1664, Fagon offered to procure plants for the garden, and through Antoine Vallot (1594–1671) the superintendent, who was also physician to the King, was appointed to travel in the Alps, Pyrenees, Auvergne and other parts. He afterwards became professor of botany and chemistry in the garden and in 1698 was made director. It was through him that two famous botanists, Joseph Tournefort (1661–1708) and Charles Plumier (1646–1704) were sent on collecting expeditions, one to the Levant and the other to America. He wrote on tobacco, cinchona and other matters, and held high office as a doctor. He died in Paris on March 11, 1718. Magnol was associated with Montpellier all his life. He took his degree there, assisted the professor of botany, in 1694 was given the chair of medicine and three years later was made director of the botanic garden, which had been founded about 1558. His writings referred mainly to the plants which grew in the neighbourhood of his native city. He died on May 21, 1715, leaving a son, Antoine, who followed in his footsteps. The genus *Magnolia* was named after him, by his countryman Plumier.

International Ornithological Congress

THE ninth International Ornithological Congress was held in Rouen during the second week in May under the presidency of Prof. A. Ghigi, rector of the University of Bologna, with M. Jean Delacour as secretary. Among the papers contributed which attracted most interest was that on his recent discovery of the Congo peacock (*Afropavo*) by Dr. J. Chapin, followed by a report on the anatomy of the bird by Mr. Percy R. Lowe. A large number of films of high merit were displayed by ornithologists of various nationalities, which showed how greatly Nature photography has advanced during recent years. Particular mention must be made of Prof. A. Allen's sound film, partly in colour, of rare and disappearing American birds and of Captain C. W. R. Knight's excerpts of the film he made when leading the National Geographic Society's 1937–38 expedition to South Africa, in which he showed three birds never filmed before—the hammerhead stork, crowned hawk eagle and secretary bird. It was agreed that the tenth International Congress should be held in America in 1942, and Dr. A. Wetmore of Washington was elected president.

International Committee for Bird Preservation

THE meetings of the International Committee for Bird Preservation, which were held in Rouen immediately preceding the Ornithological Congress, were attended by the official delegates of the national sections of fourteen different countries. The main subjects of discussion were the status of the Anatidæ throughout the world and the protection of the quail; a number of reports on progress in bird preservation in various countries were contributed. The destruction of sea-birds by waste oil was also discussed and, on the proposal of Prof. Einar Lönnberg of Sweden, a sub-committee was appointed to expedite means

of diminishing this serious evil. A further sub-committee was appointed to collate information with regard to Nature reserves throughout Europe with the view of promoting the establishment of further areas for this purpose. M. Jean Delacour (France) was elected president of the International Committee, Mr. Hoyes Lloyd (Canada) and Dr. P. G. van Tienhoven (Holland) vice-presidents, Mr. Percy R. Lowe (Great Britain) Chairman of the national sections of Europe, and M. Leon Lippens (Belgium) and Miss Phyllis Barclay-Smith (Great Britain) were re-appointed secretaries. A message expressing his interest and wishing success to the meeting was received from the Prime Minister of Great Britain.

Pre-Folsom Man in America

SHOULD preliminary accounts of the discovery of stone implements in Lake County, California, be confirmed in detail, it may be regarded as established that man existed in America in a period prior to that of the Folsom implements of the south-western United States, hitherto generally accepted as the earliest handiwork of man yet found on the American continent. According to a statement circulated by Science Service, of Washington, D.C., a joint expedition of the Carnegie Institution of Washington and the South-West Museum, Los Angeles, under the direction of Mr. M. R. Harrington, has found in ground disturbed by the plough on the shore of a brackish pond, Folsom implements in association with others of the Mohave type—a type recently found at Lake Mohave and another site, but of which the relation to the Folsom industry was in doubt. Further excavation on the Lake County site revealed the existence of a camp deposit, in which the Mohave type of implement occurred definitely below and antedating the Folsom implements. At about the same level was a new type of spear-head, to which the name of Borax Lake type has been given. Even more remarkable, however, was the discovery at a still lower level of older and cruder implements, mainly large scrapers and hand axes, belonging to a people "as yet an entirely unknown quantity in American archæology". It is calculated that on a conservative estimate this discovery would allow man on the American continent an antiquity of at least fifteen thousand years, as against the seven to twelve thousand years variously accepted for Folsom man.

Early Hebrew Script at Lachish

ON the return to England of the members of the Marston-Wellcome Archæological Expedition to Lachish at the close of excavations for the season 1937–38, further discoveries of examples of early Hebrew script on this site are reported (*The Times*, May 26). Three fragments of pottery have been found, which are inscribed in the Phenician-Hebrew script used in the famous Lachish letters, as well as scribings on the steps of the Lachish palace. The first of the three sherds shows five names of persons, followed by numerals, which probably represent quantities of wheat, oil or other commodity. The second sherd was found in a room with the remains of the pot from which it was broken, and is thought to be a receipt. The inscription begins with the phrase "In the ninth year", serving to recall the fact that it was in the ninth year of the reign of Zedekiah that Nebuchadnezzar came to Jerusalem and besieged it. As the house in which this sherd was found shows signs of having been burnt, it is thought possible that the receipt may have been written immediately before Nebuchadnezzar's second attack on Lachish in 588 B.C. The third inscription presents a certain similarity to the Lachish letters. It is very small, but there is writing on both sides, and it is evidently a letter, beginning "To my Lord". These inscriptions have been submitted to Prof. H. Torczyner, who was responsible for the decipherment of the series of eighteen letters discovered in 1935. The scribings on the face of one of the steps of the Palace, which the expedition is now beginning to excavate, are thought to have been the work of a schoolboy. With a rectangular drawing with lines across, and the picture of a lion, are the first five letters of the Phenician-Hebrew alphabet. These, reading from left to right, are in the same order as our alphabet, and are the earliest evidence for that order. They date from before Nebuchadnezzar's earlier destruction of Lachish in 597 B.C. From these discoveries the inference is drawn that the Phenician-Hebrew script was in general use in the kingdom of Judah and was being taught in the schools before the Captivity. After the Captivity the Assyrian-Hebrew script was employed.

Infestation of Grain by Insects

DESTRUCTION of stored grain and grain products by insects causes great loss to many sections of industry, probably amounting annually to not less than £500,000. More information is required before the problem can be completely tackled. The first step is a scientific survey which is to be made at once, during the period of seasonal activity of the insects. This survey has been organized on the initiative of the various sections of industry concerned, and the major part of its cost will be met by their contributions. It is to be carried out, under the auspices of the Department of Scientific and Industrial Research, by the Stored Products Laboratory of the Imperial College of Science and Technology. A conference has been formed of the representatives of interested bodies which have already agreed to co-operate in this work and its first meeting was held on May 26 in the offices of the Department of Scientific and Industrial Research. The co-operation of all sections of industry affected is essential to the success of any organized attack on these insect pests. The neglect of one section to play its part will jeopardize the success of the efforts of all the rest. The Conference, therefore, viewed with satisfaction the extent of the support so far accorded. Any organization or undertaking wishing to co-operate in this work should communicate with the Secretary of the Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, London, S.W.1.

Institute of Physics

THE annual report of the Institute of Physics for the year 1937, which has just been published, shows that its membership continues to increase in a most satisfactory way. It was just over a thousand at the end of the year, and is now considered to be representative of British physicists both at home and overseas. The most important activity of the Institute during the year covered by the report was the Second Conference on Industrial Physics held in the University of Birmingham in March 1937, the subject being "Optical Devices in Research and Industry" (see NATURE of April 3, 1937, p. 600). The various branches of the Institute in Great Britain held a number of meetings during the year and the committees of the overseas branches did valuable work in various ways. The report states that there was a further increase in the number of vacancies for physicists of which the Institute was notified, the figure being 197 for the year. Some vacancies for laboratory assistants were filled from among those holding the Institute's certificate in laboratory arts. The report states that the scope of the *Journal of Scientific Instruments*, which is produced by the Institute in co-operation with the National Physical Laboratory, has been enlarged to include items dealing with the applications of physics to industry.

A Proposed Scientific Film Society

A SCIENTIFIC FILM GROUP of the Association of Scientific Workers was formed about a year ago to encourage the growth of good instructional and documentary films, dealing both with 'pure science' and, perhaps even more important, with science as a social force. The Group has accordingly given shows of approved scientific films in London, Cambridge, Oxford and elsewhere, which have demonstrated that there is a considerable public for such films. To enable this work to continue on a more ample scale in London, however, while complying with L.C.C. regulations, it has now become necessary to consider forming a Scientific Film Society. Such a Society would be open to all interested persons, whether members of the Association of Scientific Workers or not, and would give at least four film shows a year in a London cinema on Sunday afternoons. It would not be possible to sell tickets for such shows to the general public, but a limited number of guest tickets would be available to members. Any profits arising from the Society's work would be devoted exclusively to non-commercial purposes such as the making and adapting of scientific films. Further particulars about the proposed Society can be obtained from the honorary secretary of the Scientific Films Committee, Association of Scientific Workers, Kelvin House, 28 Hogarth Road, London, S.W.7.

Joint Committee on Materials and their Testing

UNDER the above title, an interesting new form of collaboration between twenty-five of the major scientific societies and technical institutions of Great Britain has been effected: the Committee has now issued its first annual report, rendered to the councils of the collaborating institutions concerned. The principal objects of the Joint Committee are threefold: (1) to promote joint discussions on the wider aspects of the subjects of materials and their testing; (2) to assist a co-operating institution or society in the presentation of a paper or group of papers dealing with a more detailed aspect of one of these subjects; and (3) to undertake those duties with regard to international matters which properly devolve on the Joint Committee in accordance with its terms of reference. The main activity in the period reviewed by the report was the organization of a general discussion on "Notched Bar Testing" held in Manchester on October 29, 1937, in which this interesting subject was reviewed in relation to research and opinion at home and abroad. Four comprehensive papers were submitted and these papers, together with a record of the most informative discussion which resulted, are now available in pamphlet form, obtainable on application to the secretary of the Manchester Association of Engineers. The Committee is now organizing a second general discussion on various aspects of "Non-destructive Testing", which will centre around papers presented by selected experts in Germany, Holland, the United States and Great Britain, on the use of X-ray, gamma-ray, magnetic, electrical, aeronautical and other more general methods: this discussion will take place in London in October or November of the present year. The pooling of the efforts of technical bodies in promoting discussions in the wide and most important fields of the materials of construction should go a long way towards satisfying a long-felt want, and the further activities of the Joint Committee will be followed with much interest in scientific and technical centres.

Magnetic Recording in Broadcasting

IN a paper read by A. E. Barrett and J. C. F. Tweed to the Institution of Electrical Engineers on December 1, some of the methods of recording sound, especially those in connexion with their applications to Empire broadcasting, were considered. In Great Britain, very little information has been published on the subject of magnetic recording on steel tape. Dr. Stille, a German engineer, was the first to use steel tape for recording, and he made notable advances in the necessary technique. The British Broadcasting Company first tested the system in 1930 when the Empire broadcasting service was being inaugurated. Extracts from the home programmes were recorded and afterwards reproduced in the Empire transmission. The first important programme to be radiated to the Empire by this means was that on Christmas Day 1932. It included a speech by King George V. Early in 1933, Marconi's Wireless Telegraph Co., Ltd., designed a machine in which many of the mechanical difficulties experienced with earlier models were successfully overcome. It has been developed further by both the Company and the B.B.C. Magnetic recording in its simplest form can be carried out by passing a length of steel tape at constant velocity through an electromagnetic device, called a recording head, which produces variations in the magnetism of the tape. Reproduction is effected by passing the magnetized tape at the same velocity

through a device called the reproducing head, which is sensitive to the changes in the magnetism in the tape. In the ideal case these correspond to the original alternations applied to the recording head. When a new record is wanted, it is necessary to remove the previous variations in the magnetism before recording. This is done by passing the tape through a 'wiping head' which strongly magnetizes the tape. The wiping, recording and reproducing heads used in the experiments described by the authors have different types of coils and pole-pieces, but are in other respects identical.

British Museum (Natural History): Recent Acquisitions

A COLLECTION of 2,300 otoliths or 'ear-bones' has been purchased for the Fish Section of the Zoological Department. These specimens represent 570 different species, and were collected by Mr. G. A. Frost over a period of thirty years. This is the largest and most important collection of otoliths in existence, and it is especially valuable because it formed the basis of a series of papers published by Mr. Frost between 1925 and 1930. The most important gift to the Department of Entomology is the collection of Lepidoptera formed by the late Mr. Edward Meyrick. The collection is estimated to contain more than 100,000 specimens. Among the more important accessions to the Department of Geology is a collection of bones from the Lower Miocene of Kenya, including remains of mastodons, antelopes, rhinoceroses and dinotheres, collected by Archdeacon W. E. Owen; also a very fine series of the remarkable creature *Palæospondylus* from the Middle Old Red Sandstone of Achanarras, Caithness, collected and presented by Mr. C. Forster-Cooper, now the director of the museum.

PURCHASES in the Department of Mineralogy of the Museum include good crystals of cassiterite (tinstone) from Bolivia and three remarkably fine nodules of Variscite from Fairfield, Utah. The nodules, two of which are about a foot across, have been cut through and polished to show the beautiful colour of the mineral, which is nearly related to turquoise. From the same source have been obtained five splendid crystals of wulfenite (lead molybdate) from Red Cloud mine, Yuma county, Arizona. In this connexion it is of interest that Mr. A. W. G. Kinsbury, of Chewton Mendip, has recently rediscovered the mineral wulfenite at Higher Pits, Priddy, in the Mendips, and has recently presented specimens to the Museum. Four meteorites new to the collections have been acquired. The Department of Botany has received 582 specimens of flowering plants collected by Dr. Hugh Scott and Mr. E. B. Britton on the recent expedition to south-west Arabia, a district little known botanically, but historically famous by the collections made in 1775 by Linnæus's student Forskal. Also a collection of 382 specimens collected in Greenland and Ellesmere Land has been presented by Mr. R. W. Feachem. The purchases include 2,000 paintings of fungi by the late Dr. Knauth which will be of very great value in making identifications.

Research at Millport

THE annual report of the Scottish Marine Biological Association for 1936–37 shows that much good work is in progress. A scheme has been prepared for extension of accommodation which it is hoped will soon be carried out. Among other things, the library space will be considerably enlarged. Work on the growth and food of the herring has been continued by Drs. Orr, Marshall and Nicholls, mainly on the young herring. In 1935 the life-history of the herring was followed from hatching in March to metamorphosis at the beginning of June. Since July 1936 catches have been made every fortnight up to the present time in the immediate neighbourhood of the laboratory. The largest numbers were caught at dusk. Work on algal ecology has been continued by Dr. D. C. Gibb, and on animal ecology by Mr. A. J. Haddow on the growth of *Sertularia*, and by Dr. E. E. Watkin on the Amphipod genus *Bathyporeia*. In view of the failure of the herring supplies during the winter, a number of fishermen have turned their attention to "clams" as *Pecten maximus* is called locally. Preliminary work on this mollusc indicates that at five years it measures 4 inches wide, growth being indicated by winter rings, and it takes four years to reach a marketable size. It therefore grows too slowly to maintain for long the call now being made on the reserves of the species. Interesting results from examining the stomach contents of shags and coromorants are shown. The shags visiting sandy areas feed on shrimps and polychætes and on rocky shores eat prawns (*Leander*).

Vitamin B_1

WE have received from Messrs. Merck and Co. an illustrated brochure of upwards of fifty pages entitled "The Story of Vitamin B_1", which gives an up-to-date account of the chemistry, physiology and nutritional value of the vitamin. To each section is appended a useful bibliography, from which those interested can obtain more detailed information than it is possible to give in a summary review. The information supplied, nevertheless, covers the field remarkably well and brings together work which is scattered in numerous journals, so that the reader obtains a picture of our present knowledge of the vitamin in all its aspects and is readily able to see how far the work of different authors is in agreement or otherwise. After an account of the chemistry and synthesis of the vitamin, a useful section is devoted to the question of its standardization and the relationship of the different "biological units" to the international unit, information which is not readily available in summary form. Our knowledge of its physiology is then reviewed, and the following sections are devoted to its value in human and animal nutrition, the normal human requirements and the effects of a subnormal intake. The brochure is not intended for general distribution, but will be sent to investigators in the field of vitamin therapy, to medical specialists, food chemists, research workers in human and animal nutrition, colleges and universities, Government agricultural and experiment stations, and manufacturers of pharmaceutical and proprietary products.

National Physical Laboratory Abstracts

AFTER the publication of the volume of "Collected Researches" of the National Physical Laboratory at present in the press, that quarto publication will cease and will be replaced by an annual octavo pamphlet entitled "Abstracts of Papers", the first issue of which, for the year 1936, has already appeared. It extends to 65 pages, 61 of which are devoted to 140 abstracts and the rest to author and subject indexes. The title of each abstract is in Clarendon type and that of the publication in which the complete paper is to be found in italics with specification of year, volume and page. The abstracts themselves generally give the object and method of the investigation concerned in outline and the net results in detail, so that a large amount of valuable information is condensed into a small space. They are grouped under subjects. The present issue is published at 1*s.* by H.M. Stationery Office.

Esperanto for Scientific Papers and Abstracts

THE "Universala Esperanto-Kongreso" is to take place this year at University College, London, on July 30–August 6. A recent article by Dr. D. R. Duncan, published in the *Scientific Worker*, directs attention to the great potential value of Esperanto as a means of intercommunication between men of science. Being "intelligible to any educated European" without previous study, it is eminently suitable for scientific abstracts in cases where the original paper was published in a language little known outside its own country. Reports consisting largely of tables such as the "International Critical Tables" might well, it is suggested, use Esperanto instead of numerous parallel columns in different languages. Esperanto is, it appears, much used in Japan for scientific papers. A few journals outside Japan give Esperanto summaries at the end of papers published in the journal's own language, for example, the *Bull. Soc. Française des Electriciens*, the *Phare Médical* and the *Revista da Sociedade de Geografia do Rio de Janeiro*.

Society for Extending the Rothamsted Experiments

HIS GRACE THE DUKE OF DEVONSHIRE has consented to accept the chairmanship of the Incorporated Society for Extending the Rothamsted Experiments which had been held by his late father since the inception of the Society in 1904. The vice-chairmen are the Earl of Radnor and Lord Clinton. The purpose of the Society is to foster the development of the work carried out by the Rothamsted Experimental Station: the last important effort was to raise the funds for the purchase of the agricultural part of the Rothamsted Estate, which was successfully achieved in 1934, and its next effort will be in connexion with the centenary of the foundation of the Rothamsted Experimental Station which falls due in 1943.

Growth of a Sunspot

BETWEEN May 22 and 24, a large group of sunspots suddenly appeared near the central meridian and became visible to the naked eye. Measures of area taken from the Greenwich photographs show the following rapid increase in size of the spot group, which began as two or three tiny spots. The areas are corrected for foreshortening and are expressed in millionths of the sun's hemisphere.

May	22·4 U.T.	10 millionths
,,	23·3 ,,	210 ,,
,,	24·3 ,,	1060 ,,
,,	25·4 ,,	1200 ,,
,,	26·3 ,,	1390 ,,
,,	27·3 ,,	1570 ,,

Since the average group of this size takes about 8–10 days to develop fully, the very great increase in area during the first 48 hours suggested that the group would be unusually large, exceeding perhaps 2500 millionths. The maximum size appears, however, to have been reached about May 27 or 28, the group passing out of view at the western limb on May 30. These sunspots, in about latitude 8° north and longitude 12°, offered several points for study with an ordinary telescope. There was, for example, a marked drift equatorwards of the leader spot amounting to 3° or about 37,000 km. between May 24 and 27. The changes in structure between May 23 and 24 were also considerable. During the initial development of the group, the accompanying hydrogen flocculi seen spectroscopically in $H\alpha$ (and at times in $H\beta$) were persistently of enhanced intensity, although no outstanding short-lived eruptions were observed at Greenwich. The time of central meridian passage of the group was May 23·8, and it will return to the central meridian on June 20, unless by then the spots have dispersed.

Announcements

WE regret to announce the death of Dr. J. W. Mellor, C.B.E., F.R.S., author of "A Comprehensive Treatise on Inorganic and Theoretical Chemistry", on May 24, aged sixty-eight years; and of Prof. W. Stroud, Cavendish professor of physics in the University of Leeds in 1885–1909, director of Barr and Stroud, Ltd., Glasgow, on May 27, aged seventy-eight years.

SIR FRANK SMITH, secretary of the Department of Scientific and Industrial Research, has been elected an honorary fellow of the Institute of Physics. This, the highest distinction the Institute can confer, is reserved for those whom it especially desires to honour for exceptionally important services in connexion with physics or a science allied thereto; there are only seven other honorary fellows. Sir Frank Smith was a founder fellow of the Institute, and did much to help establish it on the sound basis which has assisted so much in its rapid development.

MR. A. H. R. FEDDEN has been elected president of the Royal Aeronautical Society for the year 1938–39.

THE annual inspection of the field plots and laboratories of the Rothamsted Experimental Station

will be held on June 29, beginning at 11.15 a.m. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

WE are informed that J. Wadsworth has resigned the directorship of Apia Observatory, Western Samoa, and expects to leave Samoa shortly.

MAJOR-GENERAL C. H. FOULKES writes: "It has been suggested that my review in NATURE of May 21 of Prof. Kendall's book 'Breathe Freely' might give the impression that the author is 'anti-A.R.P.'. This was very far from my intention, and in view of recent events in Spain and China, it need scarcely be said that no reasonable person could adopt such an attitude."

To encourage the reading of papers by students of fuel technology, the Council of the Institute of Fuel has decided to make an annual reward of a medal, together with a prize consisting of books and/or instruments to the value of £5 for a paper submitted by a student member of the Institute or by any student less than twenty-five years old of a university or technical college in the United Kingdom. Further particulars can be obtained from the Secretary, Institute of Fuel, 53 Victoria Street, London, S.W.1.

THE twenty-seventh annual meeting of the Oxford Ophthalmological Congress will be held at Keble College on July 6–9. Further information can be obtained from the honorary secretary, Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury.

THE twenty-fourth annual conference of the National Association for the Prevention of Tuberculosis will be held in the Great Hall of the British Medical Association House, Tavistock Square, W.C.1, on June 30–July 2.

AT the International Congress Against Rheumatism recently held at Oxford, Prof. Ralph Pemberton of Philadelphia was elected president of the International League Against Rheumatism in succession to Dr. R. Fortescue Fox. The next Congress is to be held in New York in 1940.

THE Jessie Macgregor Prize in Medical Science will be awarded next July for the best record of original work on the science of medicine. The work may be published or unpublished, but must not have been published more than three years earlier than July 1938. The value of the prize is about £50, and it is open to medical women graduates of the University of Edinburgh. Applications should be made to the Convener of Trustees, Royal College of Physicians, Edinburgh, not later than June 30.

DR. RUDOLF KREUTZ, of Cologne, has been awarded the Sudhoff Medal by the German Society of the History of Medicine.

DR. HERBERT HOOVER, the former president of the United States, has been given an honorary doctorate of the Technical University of Vienna.

DR. CARL LANDSTEINER, of the Rockefeller Institute, New York, has been awarded the Cameron Prize of the University of Edinburgh, for his work on blood grouping and blood transfusion.

THE John Phillips Memorial Medal of the American College of Physicians was recently awarded to Dr. Harry Goldblatt, professor of experimental pathology, Western Reserve University School of Medicine, Cleveland, for his work on the production of experimental hypertension in animals.

A MONUMENT to the late Mme. Curie was unveiled in Roosevelt Park, Raritan Township, New Jersey, on April 24, the seventieth anniversary of her birth.

AN Argentine Institute of Nutrition attached to the Ministry of Foreign Relations has recently been founded at Buenos Aires.

THE third International Congress for the Study of Goitre will be held on September 13–14 at Washington, when the following subjects will be discussed: (1) endemic goitre, cretinism and myxœdema; (2) thyroid gland and metabolism, nutrition and endocrine glands; (3) hyperthyroidism. Further information can be obtained from Dr. Allen Graham, 2020 East 92nd Street, Cleveland, Ohio, U.S.A.

THE sixteenth International Congress of Physiology will be held at Zurich on August 14–18 under the presidency of Prof. W. R. Hess. It will consist of six sections devoted respectively to general and comparative physiology, biophysics, biochemistry, applied physiology (work, sport and aviation), psychophysiology and pharmacology. Further information can be obtained from Prof. E. Rottlin, Sonnenweg 6, Basel, Switzerland.

A NOTE upon the "Scialyscope", which provides a means by which surgical operations may be viewed by a number of students in a room adjacent to the operation theatre, was published in NATURE of April 30, p. 780. Mr. G. Davidson, director of Technical Lights and Equipment, Ltd., 9–10 Bentinck Mews, Marylebone Lane, London, W.1, sends us a copy of a booklet compiled when the instrument was originally invented, as well as copies of illustrated French leaflets and a booklet showing installations of it at different hospitals. Further information can be obtained from that firm.

ERRATUM. In NATURE of May 28, p. 980, paragraph entitled "Condensation on Board Ship", line 2, for "J. S. Duly" read "S. J. Duly".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1018.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A Method of Investigating Electron-Inertia Effects in Thermionic Tubes

IT is well known that the phenomena exhibited by thermionic vacuum tubes begin to alter when the frequency of the potential applied to their electrodes is increased so as to approach the inter-electrode transit-time of the electrons. It is convenient to group all these phenomena under the name of electron-inertia effects. They include the production of high-frequency oscillations by the magnetron and the Barkhausen-Kurz method, and the occurrence at very high frequencies of a phase shift of the conductance of a diode and of the mutual conductance of a triode, and increased damping in the grid circuit of a triode.

Many theoretical investigations of these effects have been made, but it is not easy to subject them to experimental test because of the difficulties encountered in working at the very high frequencies involved. It is, for example, very difficult to measure the amplitudes or phase relations of the potentials and currents, and if it is desired to apply high-frequency potentials to the electrodes in a search for resonance effects, it is generally necessary to do so by means of a Barkhausen-Kurz oscillator, the amplitude and frequency of which are not conveniently varied. If the frequencies of the oscillations involved in these investigations could be made very much smaller, the experiments would be much easier, and could be carried out in considerably greater detail.

This desirable effect can be achieved if, instead of electrons, more massive ions are used. It can be demonstrated that, in a tube with given potentials on the electrodes, the equations of motion for an ion of mass M are the same as those for an electron of mass m, provided the emission current is decreased in the ratio $\sqrt{m/M}$ and the time in all the equations is increased in the ratio $\sqrt{M/m}$. As a source of positive ions, it is convenient to use either a tungsten filament situated in a vapour of cæsium, according to the method first explained by Langmuir[1], or a platinum strip coated with an emitting substance, as described by Jones and Blewett[2].

In an investigation of some electron-inertia effects, we have used tubes of both kinds. A cæsium tube was made from the electrode system of an A.T. 40 triode, and a tube with plane electrodes having a variable spacing was used with a lithium emitter of the Jones and Blewett type. The more detailed experiments were made with the cæsium tube. An accelerating potential was applied to the grid and a small retarding potential to the plate, so that in the absence of any oscillating potentials no current was received by the plate. An ordinary retroactive oscillator was used to apply to the plate a high-frequency potential of amplitude less than the steady retarding potential. For most values of grid potential, no steady plate current was observed, but certain values of potential gave rise to a flow of plate current. The value of grid potential which gave rise to this plate current was dependent upon the frequency of the oscillating potential applied to the plate, and the phenomenon was presumably due to a resonance between the frequency of the applied E.M.F. and the frequency of oscillation of the ions about the grid wires. Similar results have been given by Gill and Donaldson[3] for an electron triode. If this is the correct explanation, the theoretical relation[4]

$$\lambda \sqrt{E_g} = 2{,}000\, d_g \sqrt{M/m} \qquad (1)$$

should hold between the grid potential (E_g) in volts, the wave-length (λ) in cm. corresponding to the applied frequency, and the grid diameter (d_g) in cm. This relation was, in fact, found to hold approximately. The wave-lengths lay between 300 m. and 800 m. for values of E_g between 450 and 75 volts, whereas if electrons had been used the wave-lengths would have been of the order of 1 m. It was found that the closeness with which expression (1) was obeyed depended on the amplitude of the applied potential, and on the emission current. We hope to give a detailed account of these effects elsewhere: the purpose of the present note is simply to direct attention to the method of investigation.

Similar effects were observed when the plane electrode tube was used with lithium ions. Equation (1) was again found to hold approximately, and was also found to represent correctly the effect of altered electrode spacing. With the lighter lithium ions the wave-lengths involved were of the order of 100 m. for potentials of the order of 200 volts and electrode spacing of the order of 1 cm.

It should be pointed out that since the emission currents in the case of positive ions are small, the effective impedance of a tube is large, and it has not been possible to use the above-mentioned tubes to produce oscillations of the Barkhausen-Kurz type. By making a cæsium vapour tube with a large emitting surface and by keeping the bulb at a high temperature so as to increase the emission current, we hope to be able to produce Barkhausen-Kurz type oscillations and investigate the mechanism of their production.

S. KOWNACKI.
J. A. RATCLIFFE.

Cavendish Laboratory,
Cambridge.
May 2.

[1] Langmuir and Kingdon, *Proc. Roy. Soc.*, **107**, 61 (1925).
[2] Jones and Blewett, *Phys. Rev.*, **50**, 464 (1936).
[3] Gill and Donaldson, *Phil. Mag.*, **15**, 1177 (1933).
[4] Megaw, *J. Inst. Elec. Eng.*, **72**, 313 (1933).

The Florisbad Skull

SINCE its discovery by Prof. T. F. Dreyer[1] in 1932, the Florisbad skull has been discussed by the leading anthropologists[2] of South Africa. No one in Europe, so far as I know, has had an opportunity of examining a cast of the specimen. Thanks to Prof. Raymond Dart, of Johannesburg, I have been given this opportunity, and as a result I wish to confirm the importance of the discovery to all students of human evolution.

The primitive Rhodesian skull found in the mine at Broken Hill in 1921 is no longer an isolated antique. The Florisbad skull reproduces the massive and peculiar features of the Rhodesian forehead. But behind the forehead, the Florisbad skull assumes the characters of the Boskop skull. Indeed it may be regarded, as Dr. Alex. Galloway has maintained, as a transition from the Rhodesian to the Boskop type, the latter heralding the modern races of South Africa—Bushman and Hottentot. In its cheek bones and its upper face, the Florisbad fossil reproduces features seen in modern Bushmen and Hottentots. This new skull is a mosaic of Rhodesian, Boskop and Bush characters.

The geological ages of the Rhodesian and Boskop fossils are not known, but from the very primitive features of the Rhodesian skull and brain, one is tempted to ascribe it to a mid-pleistocene date. The large-brained Boskop skull one supposes to be much later in date—perhaps upper pleistocene. The Florisbad skull was found in a stratified deposit at a depth of 20 ft. The stone implements and fossil fauna found with the skull has led Prof. Dreyer to assign it to an early phase of the Middle Stone industry of South Africa. We may presume, therefore, that Florisbad man may have been contemporary with the Neanderthal race of Europe.

The brain of Rhodesian man measured about 1,300 c.c.; that of the Boskop man about 1,600 c.c.; that of the Florisbad man about 1,450 c.c.

The discovery of the Florisbad skull supplies evidence I have been in need of. The discoveries of fossil types already made leaves little doubt that South Africa, like Java, has been a centre where evolutionary change pursued its own independent course, ending in the Bushman and Hottentot types of to-day. It seemed hazardous to presume that the Rhodesian type, with its great supraorbital ridges and small brain, could be transformed into the Boskop type, with voluminous brain and smooth forehead, but that such a transmutation has really occurred seems to be assured by Prof. Dreyer's discovery.

ARTHUR KEITH.

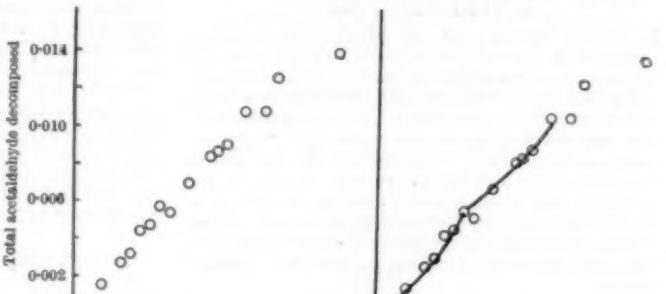
Buckston Browne Farm,
Downe, Kent.
May 25.

[1] Dreyer, T. F., *Proc. Kon. Akad. v. Wetensch. te Amsterdam*, **38**, 119 (1935). A description of the skull with an account of the endocranial cast by Dr. C. U. Ariens Kappers. The endocranial cast has has also been described by A. J. Meiring (*S. Afr. J. Sci.*, **33**, 960; 1937). An account of the cultural and faunistic evidence is given by Prof. Dreyer in *Argeologiese Navorsing van die Nasionale Museum* (Bloemfontein), **1**, 65 (1938).

[2] Drennan, M. R., *S. Afr. J. Sci.*, **33**, 64 (1937); Dart, R., *Report of XVI International Geological Congress* (1936); Galloway, Alexander, *Amer. J. Physical Anthrop.*, **23**, 1 (1937); *S. Afr. J. Sci.*, **34**, 89 (1937).

Decomposition Reactions of Organic Compounds in the Gaseous State

IN NATURE and elsewhere, Prof. M. W. Travers and his collaborators have published the results of experiments on gaseous decomposition reactions, and have claimed that in a number of respects their results invalidate work published from this laboratory in the course of the past twelve years. So long as these views have appeared as the expression of the personal point of view of Prof. Travers, I have not wished to intervene, but since I have seen statements from which I differ strongly repeated at second-hand, I ask leave to make two comments.



(1) Some of the statements made in the papers of Prof. Travers convey the impression that we have relied uncritically on pressure changes as indications of reaction rates. This is not correct. In some cases the reaction has been followed by analytical methods over its whole course[1], and in others a mathematical method has been used to show that the pressure changes employed were in fact proportional to the initial transformation rate over the whole range used[2].

(2) I am not competent to summarize the views of Prof. Travers, since I am far from understanding them, but the major difference of opinion relates to the degree of complexity of certain processes. According to Prof. Travers, in the thermal decomposition of, for example, acetaldehyde "the initial stages of thermal decomposition show strong self-acceleration, followed by a sudden slowing down. This slowing down is always accompanied by the speeding up of another process, but it generally happens that the secondary process begins to speed up before the break point, and slows down again after the break point is passed".

In the accompanying graphs, I have plotted in *A* the results given by Seddon and Travers[3] for the decomposition of acetaldehyde at 400°. It seems to me quite obvious that these points are grouped within the experimental error about a single curve somewhat concave to the time axis, an interpretation which would have tallied with our results and with those of Letort. (Seddon and Travers admit the possibility of a slight error in the initial timing.) In *B* is reproduced the curve which Seddon and Travers draw through the *same points*.

This summarizes and typifies the main matter at issue between the two schools of thought. Prof. Travers has given his evidence and stated his beliefs as he has every right to do, but since the conclusions

are now being reported without an examination of the evidence itself, I feel compelled to direct attention to the nature of the observations, and to say that in my opinion they are of a kind inadequate to justify the kind of deductions which have been made from them about the kinetics of these reactions.

C. N. HINSHELWOOD.

Physical Chemistry Laboratory,
Balliol College and Trinity College,
Oxford.
May 2.

[1] For example, *Proc. Roy. Soc.*, A, **149**, 340, 355 (1935); A, **146**, 345 (1934); A, **115**, 215 (1927).
[2] For example, *Proc. Roy. Soc.*, A, **146**, 334 (1934).
[3] *Proc. Roy. Soc.*, A, **156**, 234 (1936) Table VI.

Electron Multiplier as an Electron Counting Device

IN an earlier communication[1], I have described the possibility of using an electron multiplier, based on the secondary emission principle, for the detection of individual electrons by cooling the multiplier for the purpose of suppressing the thermal emission in liquid air. I stated there that this method of counting individual electrons does not necessarily require the use of liquid air, provided multiplying electrodes, with fairly great secondary emission factor and sufficiently high work function are used. There is a large discrepancy in the data of various papers published on the subject of work function and secondary emission of a surface. Experiments had to be carried out to determine whether a surface satisfying our requirements could be found, and we found the following surface satisfactory from the above point of view:

Very thin layers of barium oxide on a nickel base activated by the method normally used for oxide-coated cathodes will easily give a multiplication factor of $T = 2{\cdot}5$, with a primary electron velocity of 200 volts. A multiplication of about 10,000 times was achieved in a ten-stage multiplier. The thermionic emission (at room temperature) and field emission of the active surfaces in this multiplier are negligible.

On this basis an apparatus was built consisting of the above multiplier and an amplifier with a cathode ray tube. The zero effect of the counting device was about 5 per minute. It was possible to detect individual electrons emitted by the cathode when illuminated by a very weak beam of light or by heating the cathode by a built-in heater. The small zero effect is probably due to cosmic rays. The device can also be used for the counting of gamma rays.

The maximum resolving ability of the above multiplier with an amplifier of suitable construction is 10^{-6} sec.; this greatly surpasses that of the gas-filled counters.

Further details will appear in a paper to be published elsewhere.

Z. BAY.

Tungsram Research Laboratories,
United Incandescent Lamps and
Electrical Company,
Ujpest, nr. Budapest.
April 25.

[1] Bay, Z., NATURE, **141**, 287 (1938).

Rectifying Properties of Crystals

B. K. Sen[1] has recently reported in NATURE, that the rectifying properties observed by Khastgir[2] were found also in some crystals having a centre of symmetry. As in this case a volume rectification must be excluded, Sen concludes that generally the observed rectifying properties should be ascribed to a superficial phenomenon.

So long ago as 1935, I reported the results of experiments on unipolar conduction in carborundum monocrystals, in the direction of the principal polar axis. The experimental procedure I used enabled me to distinguish between a superficial rectification of the 'blocking layer' type, and a true volume rectification. This volume rectification is very less marked and in opposite direction to the surface rectification.

The facts observed by Khastgir must be ascribed substantially to a very strong superficial effect. On the other hand, my experiments demonstrate the existence of a true volume rectification, the existence of which is a natural consequence of the lack of symmetry in a crystal with polar axis[4].

There are thus three different cases:

(1) Deaglio's experiments (true volume rectification).

(2) Khastgir's experiments on carborundum (energical surface rectification concealing the volume rectification).

(3) Sen's experiments on crystals with centre of symmetry (surface rectification only).

ROMOLO DEAGLIO.

Istituto Elettrotecnico Nazionale,
Turin.
May 7.

[1] Sen, B. K., NATURE, **140**, 1102 (1937).
[2] Khastgir, S. R., NATURE, **135**, 148 (1935); Khastgir, S. R., and Das Gupta, A. K., *Indian J. Phys.*, **9**, 235 (1935).
[3] Deaglio, R., *C.R.*, **200**, 1303 (1935); *R. Acc. Scienze Torino*, **70**, 626 (1935).
[4] Osterberg, H., *Phys. Rev.* (2), **50**, 1187 (1936).

Formation of Negative Ions at Surfaces

IN a recent series of papers[1], one of us (F.L.A.) has discussed experiments, carried out with the assistance of Dr. J. C. Milligan, which led to the discovery of a new process of negative ion formation. This process was the formation of negative ions at metal surfaces by bombardment of the surface with positive ions, the negative ion being presumably formed by the positive ion capturing two electrons from the surface. After acceleration away from the surface, the negative ion has an excess energy which is acquired from the acceleration of the positive ion towards the surface. Dr. R. A. Smith[2] has recently carried out a quantum theoretical investigation of the above process which satisfactorily accounts for the experimental results.

Further work carried out during the past year has shown that the negative ion emitted from the surface need not necessarily be of the same element as the positive ion which leads to its formation. Sloane and Press[3] report in to-day's NATURE that they have repeated these experiments and have come to the same conclusion.

Our new results show that five peaks of light negative ions are obtained by the mass-spectrograph

when the electrodes are bombarded by positive ions of argon or nitrogen or mercury, and that practically identical negative ion curves are produced by each type of positive ion. The probable mass numbers of these peaks are about 16, 24, 32, 37, and 44. In each set of curves, using positive ions of argon, nitrogen or mercury, the peak of mass number about 24 (possibly C_2H) is about a hundred times as strong as any of the other peaks. All the negative ions have excess energy and increase in intensity with increase of the positive ion current. With the filament properly degassed and liquid air on all traps, no peaks are detectable, thus showing that good vacuum conditions can be obtained in our apparatus. These new results show that no negative ions of nitrogen are formed, the N^- peak formerly reported being probably O^- produced from occluded oxygen in the surface ejected by the impact of nitrogen positive ions, as is shown to occur below.

The apparatus was then flushed out with oxygen and several runs taken in this gas. The negative ion analysis curves were now entirely different from those obtained in argon, nitrogen and mercury vapour. The main peaks in oxygen were those of mass number 16 and 32, representing O^- and O_2^-. The O^- peak was very intense, being 140 times as high as it was in the other gases. The O_2^- peak had increased by a factor of about 65. The peak at about 24, which was so intense in argon, nitrogen and mercury vapour, was barely perceptible, as were also the other peaks.

The oxygen was then all pumped out and the electrodes bombarded with positive ions of mercury by removing the liquid air traps. The main peak in the analysis curves of negative ions produced on the filament was still O^-, being 24 times stronger than any other peak. For the ions produced on the gauze electrode E_3 of our apparatus[1], the main peaks were those of mass numbers 24 and 32. Re-flashing the filament considerably reduced the O^- peak from the filament, but had no marked effect on the ions from E_3.

The results in oxygen, which are in agreement with those already published[1], appear to show that both O^- and O_2^- are produced by positive ions of oxygen capturing two electrons from the surface, as was previously suggested. However, these ions can also apparently be produced by bombardment by positive ions of mercury of a surface which has absorbed oxygen. Flashing of the filament reduces its content of absorbed oxygen, and so reduces the O^- peak from the filament. The other peaks probably arise in the same way from other gases and vapours either occluded in the metal or adsorbed as a monomolecular layer on its surface.

The latter mode of formation of negative ions of one element by bombardment of the surface with positive ions of another element may be due to a collision of the second kind. Thus a positive ion of mercury, nitrogen or argon may capture an electron into an excited state, the excitation energy being transferred to a gas atom on the surface by a collision of the second kind. This excited atom then captures a second electron from the metal by a resonance process. This mode of formation is the same as the one formerly suggested (by F.L.A.) to account for those negative ions which are formed from their own positive ions, except that in the new process transfer of excitation and kinetic energy occurs between the two species of atoms.

When a high yield of light negative ions is produced by Hg^+ ions, the number of Hg^- ions formed would be considerably decreased. This may account for their not having been observed by Sloane and Press.

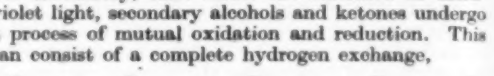
F. L. ARNOT.
CLARK BECKETT.

University,
St. Andrews.
May 14.

[1] Arnot and Milligan, *Proc. Roy. Soc.*, A, **156**, 538 (1936). Arnot, *Proc. Roy. Soc.*, A, **158**, 137 (1937). Arnot, *Proc. Roy. Soc.*, A, **158**, 157 (1937).
[2] Smith, *Proc. Roy. Soc.*, A, in the press.
[3] Sloane and Press, NATURE, **141**, 872 (1938).

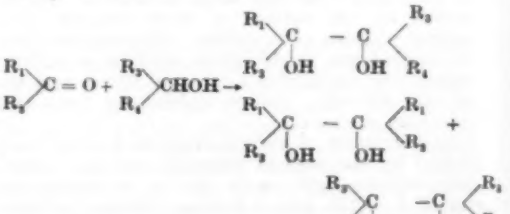
Photochemical Interaction between Ketones and Secondary Alcohols

IT has been observed by various authors[1] and recently confirmed by an extensive investigation in our laboratory, that under the influence of ultra-violet light, secondary alcohols and ketones undergo a process of mutual oxidation and reduction. This can consist of a complete hydrogen exchange,

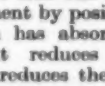
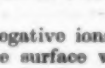


(I)

or of the formation of pinacols,



(II)

In both cases the characteristic reaction is the migration of the hydrogen atom H* of the alcoholic group  , which may occur in an addition compound formed primarily from the alcohol and the ketone[2]. (That the hydroxylic hydrogen atom is not primarily required for the reaction follows from the fact that similar condensation reactions occur between ketones and the methyl ethers of secondary alcohols.) The radical  can be stabilized by giving up the hydrogen atom of the hydroxyl group or by combining with a second, similar radical, the actual course of the reaction probably depending on the nature of the reactants.

It is probable that dissociation of the C—H* group is not the primary photochemical reaction. As a matter of fact, phenylmethylcarbinol, $C_6H_5.CHOH.CH_3$, is not racemized by ultra-violet irradiation, although dissociation of the C—H*-bond would have such an effect due to the configurational instability of radicals[3]. On the other hand, irradiation of an equi-molecular mixture of optically active phenylmethylcarbinol and acetophenone gives an

optically inactive mixture of the diastereomeric acetophenone-pinacols, although one of them could have been formed in the active state. So we are led to the assumption that the primary photochemical step is the activation of the carbonyl compound, which is in accord with the known absorptive capacity of carbonyl compounds, and the relative transparency of alcohols. This activated form, for example, the diradical $R_1 \diagdown C—O$ [4], $R_2 \diagup$: :, reacts with the alcohol, $(R_3)(R_4)CHOH$, splitting the C—H* bond and giving two free radicals — configurationally unstable — which can dimerize symmetrically or asymmetrically (II) or stabilize by a second oxidation-reduction process (I).

The above facts and considerations are able to throw some light on the photochemistry of ergosterol and similar compounds. Irradiation of ergosterol in a neutral solvent gives lumisterol without configurational change in the secondary alcoholic group CH*OH [5], but in presence of an acceptor compound (eosine) which suffers activation first, the H* is removed and a bimolecular product (ergopinacol)[6] is formed[7].

A detailed report on our experiments will be published elsewhere.

CH. WEIZMANN.
Y. HIRSHBERG.
E. BERGMANN.

Daniel Sieff Research Institute,
Rehovoth, Palestine.
April 3.

[1] See e.g. Ciamician and Silber, *Ber. dtsch. Chem. Ges.*, **36**, 1575 (1903) and later.

[2] Wolf, K. L., and Herold, *Z. physikal. Chem.*, B, **5**, 124 (1929); **12**, 165, 194 (1931).

[3] Pauling and Whriand, *J. Chem. Physics*, **1**, 362 (1933). Compare also Bergmann and Schuchardt, *Liebig's Ann.*, **487**, 225 (1931).

[4] Bodenstein, *Z. physikal. Chem.*, B, **12**, 151 (1931). Farkas and Hirshberg, *J. Amer. Chem. Soc.*, **59**, 2450, 2453 (1937).

[5] Windaus and Dimroth, *Ber. dtsch. Chem. Ges.*, **70**, 376 (1937).

[6] For the formula of this compound see Lettré and Inhoffen, "Sterine, Gallensauren, etc.", p. 135 (Stuttgart, 1935); Inhoffen, *Naturwiss.*, **25**, 125 (1937). This ergopinacol seems to be formed from ergosterol through a series of hydrogen migrations; otherwise it would be inconceivable that a hydrogen atom at C_7 should leave the molecule.

[7] The analogous reaction is given by dehydro-ergosterol dehydrolumisterol and dehydro-cholesterol. Windaus and Linsert, *Annalen*, **465**, 148 (1928), Dimroth, *Ber. dtsch. Chem. Ges.*, **69**, 1123 (1936); Urushibara, *Chem. Centralblatt*, **1**, 2982 (1937).

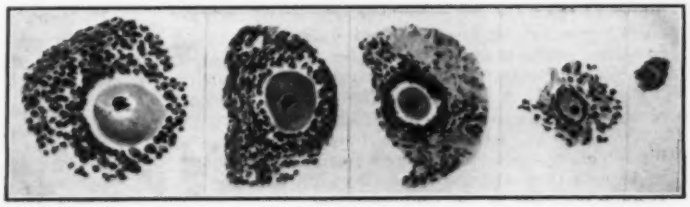
Ovotrophic and Folliculoplasic Hormones

RECENT findings have forced me to distinguish the nucleotrophic or *mitoplasic* from the *plasmotrophic* effect of hormones; plasmotrophy being tissue growth by cellular hypertrophy alone, mitoplasia, growth by mitogenesis as well.

Those hormones of the steroid series which have at least *one* oxygen-bound valency in the — 17 position are usually mitoplasic; for example, œstrone. Colchicine, by arresting mitosis in the metaphase, helps to reveal mitoplasia (Dustin and co-workers), a dosage of 4 γ per gram body weight being optimal for mitotic immobilization at least fifteen hours after injection in the rat.

Pituitary hormones are generally plasmotrophic, as seen by their effect on such tissues as cartilage, mammary gland, adrenal cortex, corpus luteum, thyroid, and the interstitial cells of Leydig. The cells of the ductless glands secrete hormones when enlarged, this secretory capacity being latent when they become atrophic owing to the absence of the anterior pituitary. In general, plasmotrophy increases the specific productivity of all cells and the functional capacity of organs such as liver and muscle.

Although with the aid of colchicine Dustin's collaborators were able to observe a slight degree of mitoplasia in the thyreotrophically stimulated thyroid, the general appearance of the gland suggests a predominantly plasmotrophic effect; the mitoplasia might in this instance be due to contamination of the thyreotrophic fraction with another pituitary factor having the capacity to engender, perhaps in non-thyroid tissue, a factor mitoplasic for thyroid cells. Such a mechanism would be analogous to the plasmotrophic stimulation of the Leydig cells of the testis to produce steroids, mitoplasic for male genital accessories and perhaps also for germinal cells.



CAMERA LUCIDA DRAWINGS OF FOLLICLES OBSERVED SIMULTANEOUSLY IN A SINGLE OVARY AFTER INJECTION OF COLCHICINE INTO A PREGNANT RAT. × 450.

Although follicle stimulation is an apparent exception to the rule that pituitary substances are mitoplasic only indirectly or not at all, it has been easy to show with colchicine that egg development entails follicular mitoplasia. The mechanism of follicle-ripening is elucidated by the following observations:

(1) After hypophysectomy in the rat, small ova remain small, medium-sized ova persist for weeks, as also do corpora lutea, and large ova become atrophic. No additional primary follicles develop, the medium-sized ones continue to show mitosis for about three weeks, and Graafian follicles showing an antrum degenerate. *The occurrence of follicle mitoplasia between two and three weeks after hypophysectomy is convincing evidence that follicular mitoplasia is not immediately dependent on the pituitary: I assume that it depends on the ovum.*

Ova that are medium-sized at the date of hypophysectomy persist in the production of their mitoplasic factor until such time as they degenerate; in which respect they resemble the cells of the corpus luteum, which persist and maintain pregnancy if hypophysectomy is done on or after the twelfth day of pregnancy in the rat, although their removal before term almost invariably leads to fœtal death.

(2) Five camera lucida drawings (above) of follicles observed simultaneously in a single ovary following colchicine injection of a pregnant rat, illustrate the frequency of mitosis with reference to egg size. In normal and hypophysectomized rats, mitosis begins only when the ovum has more than doubled its initial diameter (more than twenty-five times its initial volume); and the maximum frequency of mitosis occurs at a point when the diameter is five or seven

times (volume about 125–350 times) that of a primordial ovum. After death or expulsion of the ovum, a few mitoses sometimes occur, but mitoplasia soon ceases; the granulosa cells become pyknotic, and wandering eosinophil cells invade the follicle, which degenerates and disappears, or in suitable conditions forms a corpus luteum.

(3) These observations were found to hold good also for the ovary of the mouse, guinea pig, rabbit and dog. Rat ovaries with and without gonadotrophic stimulation were compared in pregnant, normal adult, infantile and hypophysectomized animals. It was consistently clear that pregnancy does not interrupt the follicular mitoplasic activity of medium-sized egg-cells. A large egg-cell failing to produce follicular mitoplasia was occasionally found, but never a mitoplasic follicle without a larger egg-cell.

Conclusion. A follicle-ripening anterior pituitary or anterior pituitary-like factor does not exist.

The pituitary generates an ovotrophic hormone, for which a separate existence from the luteinizing and interstitia-stimulating factors of the gonadotrophic complex is yet undetermined.

The ovum itself produces the folliculoplasic hormone, to isolate which investigation of a suitable technique is in progress. J. FREUD.

Pharmaco-Therapeutic Laboratory,
University of Amsterdam.
April 25.

Histamine and the Action of the Thyroid Gland

IN previous investigations[1] we have pointed out that irradiation of white mice with ultra-violet light is accompanied by a loss of body weight. Furthermore, we have noted[2] that there is a relation between the loss of body weight and the function of the thyroid gland. It was possible to demonstrate that the acetonitrile test of Reid Hunt[3] becomes positive during the time in which a lowering of body weight of the irradiated mice was found. Because there is a connexion between erythema-producing power of ultra-violet light and the weight loss, the conclusion was drawn that the formation of histamine-like substances seems to be responsible for the activation of the thyroid gland and the loss of body weight.

In order to test this belief, the following experiments were carried out: histamine hydrochloride (0·01–0·04 mgm.) was injected subcutaneously into white mice five times weekly for fourteen days. The diet of the mice was bread (32 gm. weekly) and water *ad libitum*. The body weight was controlled every week.

We found that it is possible by this means to effect a lowering of the body weight in the injected mice, but not in every case. Apparently, the initial level of the activity of the thyroid gland is important. In those cases, however, where it was possible to obtain a lowering of the body weight, there was also a positive acetonitrile test.

The accompanying table will serve as a preliminary report:

No.	Average body-weight difference between treated and untreated mice	Acetonitrile test for thyroid according to Reid Hunt. (Doses 1·5 mgm./gm. body-weight)		
		Surviving 24 hours		
		Histamine treated	Untreated	Result
55	− 6 per cent	7 from 10	2 from 9	positive
58	0	4 from 7	7 from 7	inverse
60	− 3 per cent	5 from 9	4* from 8	positive

* One of these was moribund.

These findings seem to be supported by the findings of Dietrich and Schwiegk[4]. These authors pointed out that injection of histamine produces a higher blood flow in the thyroid gland, as well as in other parts of the circulation, and on the basis of this result a more intense functioning of the gland is understandable.

The observation of a higher degree of activity of the thyroid gland after repeated injections of histamine seems to support further the histamine theory of general ray reactions[5].

Additional data will be published later.

F. ELLINGER.

Biological Institute,
Carlsberg Foundation,
Copenhagen.
May 7.

[1] *Radiology*, in the press.
[2] *Skand. Arch. physiol.*, in the press.
[3] *Amer. J. Physiol.*, **62**, 257 (1923).
[4] *Arch. Exp. Pathol. u. Pharmakol.*, **185**, 53 (1932).
[5] comp. Ellinger, F., "Die biologischen Grundlagen der Strahlenbehandlung" (Berlin, 1935).

Development of the Giant Salivary Gland Nuclei of *Drosophila*

THE development of the giant spireme-like salivary gland nuclei of various species of *Drosophila* larvæ (*repleta*, *melanogaster*, *funebris*, *robusta* and *virilis*) has been studied in preparations of whole organs and sections stained after Feulgen.

The nuclei of the salivary glands and other organs of very small larvæ have the structure shown in Fig. 1. The chromocentre is formed at the telophase through the fusion of the heterochromatic proximal ends of the chromosomes. It is situated at the periphery of the nucleus and is always connected with the nucleolus lying in the centre of the nucleus. On the surface of the nucleus are located thread-like paired chromosomes twisted together. Each of these chromosomes consists of two closely connected genonemata. The proximal ends of the chromosomes are united with the chromocentre; owing to this it is possible to determine their haploid number. When the focus is changed a reticulum of the resting nucleus is seen.

The genonemata do not stain after Feulgen and they are well visible owing to the lengthwise arranged

1. 2.

Fig. 1.

A SALIVARY GLAND NUCLEUS FROM A SMALL LARVA (1·5–2 MM. LONG) OF *D. repleta*. ×3200.

Fig. 2.

TWO PAIRED CHROMOSOMES TWISTED TOGETHER. FROM THE CÆCUM OF THE MIDGUT OF A LARVA OF *D. repleta*. ×3200.

chromomeres. The dimensions and the number of the chromomeres augment with the growth of the larva; the genonemata lengthen and form numerous curves.

The genonemata are uncoiled and straightened with the growth of the nucleus. For this reason, sections of the genonemata including lengthwise arranged chromomeres correspond to single chromomeres of the nuclei of young larvæ. A close contact between homologous chromomeres of two chromosomes twisted together becomes possible and this results in the appearance of bands (Fig. 2).

In a larva 3 mm. long, bands may be noted in all the organs where spireme-like nuclei are found, the chromosomes being at the same time very fine (Fig. 3). Their diameter gradually increases, that is, growth of the chromosomes sets in. After this the number of chromonemata (genonemata with chromomeres and chromoplasma) is doubled and therefore the diameter of the chromosomes also becomes doubled.

Fig. 3.

A SALIVARY GLAND NUCLEUS FROM A LARVA (3 MM. LONG) OF *D. repleta*. THE PROXIMAL ENDS OF THE CHROMOSOMES ARE CONNECTED WITH THE CHROMOCENTRE. ×3200.

A second duplication of the chromonemata occurs in larvæ of the last age. In the nuclei of the cæcum of the midgut the number of chromonemata is doubled once. In some organs no such duplication is to be noted. In some organs (œsophagus, ring-gland) the spireme-like nuclei are never formed. Here the nuclei as well as the nuclei in different organs of the imago may be compared with definite stages of development of spireme-like salivary gland nuclei. Small nuclei are comparable with the nuclei of very young larvæ, larger ones with those of larger larvæ where the chromosome bands have not yet been formed.

In the present work the identity has been established of the structure of all resting nuclei in the larvæ and imago of *Drosophila* and the absence of any essential difference between them and the spireme-like salivary gland nuclei. This structure of the resting nuclei, that is, pairing of homologues and their connexion with the chromocentre, is retained from the last telophase. This proves the continuity of the chromosomes.

S. L. FROLOVA.

Institute of Experimental Biology,
Moscow. April 25.

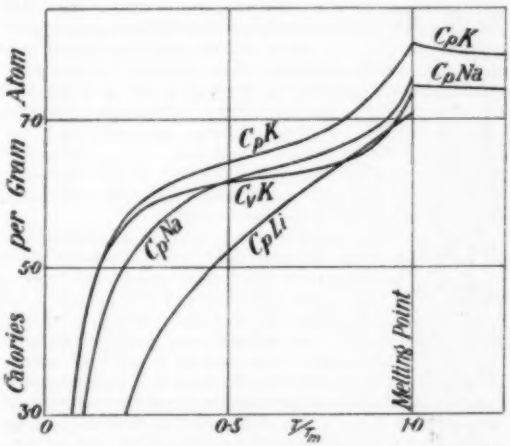
Specific Heat of the Alkalis

IN the alkali metals, the electrons may be considered as degenerate in the Fermi-Dirac sense and incapable of contributing more than a few per cent to the specific heat. The explanation of any effect which exists is therefore probably to be sought in the lattice itself.

We have recently completed measurements of the true (as opposed to mean) specific heat of potassium over the temperature range − 70° C. to + 336° C. and the results show the normal tendency to attain a constant value of the order of $3R$, followed by an abnormal rise of specific heat, setting in at about room temperature and extending up to the melting point (63·4° C.). The potassium was of a high degree of purity and was distilled *in vacuo* into the calorimeter in which the measurements were made. Further, the rate of increase of abnormal specific heat with temperature is of a much lower order than that which impurity should produce, since spurious specific heat due to premelting caused by impurity may be expected to increase as the inverse square of the difference of the temperature from the melting point.

We are therefore of the opinion that the abnormal rise of specific heat is a property of pure potassium.

We have also made some preliminary measurements of the specific heat of lithium over a range of 180° immediately below the melting point. These, combined with the experimental data of others given in Landolt-Bornstein's "Tables" and some values obtained by Bidwell[1], have been used to draw the experimental curve shown in the accompanying



graph, on which have also been plotted our experimental values of C_p for potassium, and the C_v values derived from them. The values for C_p for sodium have also been plotted from Landolt-Bornstein; unfortunately, there are insufficient data for rubidium and cæsium.

For the purpose of comparison a common temperature scale, obtained by expressing the temperatures as fractions of the absolute melting temperature, has been used. It will be observed that the abnormal rise of specific heat, extending over a considerable range below the melting point, appears to be a common property of all three elements.

The abnormal behaviour of the specific heat of lithium and sodium has been already noted by

Bidwell[1], who suggests that the abnormality may be caused by a gradual breakdown of the lattice as the melting point is approached. In support of this hypothesis he quotes observations[2] which tend to show that the X-ray diffraction patterns disappear also well below the melting point.

Whatever the cause of the phenomenon, we wish to emphasize that, so far as present knowledge goes, it is an effect which is characteristic of the alkali metals, since it is almost absent in other elements, for example, mercury[3], bismuth[4], iodine[5] and lead[6], on which measurements of true specific heat have been made right up to the melting point.

L. G. CARPENTER.
T. F. HARLE.
C. J. STEWARD.

Physical Laboratory,
University College,
Southampton.
April 13.

[1] Bidwell, *Phys. Rev.*, **28**, 584 (1926).
[2] Bidwell, *Phys. Rev.*, **27**, 381 (1926).
[3] Carpenter and Stoodley, *Phil. Mag.*, **10**, 249 (1930).
[4] Carpenter and Harle, *Proc. Roy. Soc.*, A, **136**, 243 (1932).
[5] Carpenter and Harle, *Phil. Mag.*, **25**, 193 (1937).
[6] Klinkhardt, *Ann. Phys.*, **84**, 167 (1927).

Free Field Calibration of Microphones

THE determination of the 'field calibration' of a microphone, that is, the sensitivity under free space conditions, has been rendered difficult in the past by the presence of air currents comparable with the velocities to be measured, or field irregularities and uncertainties in direction due to reflection from the walls in a small enclosure. If, in the case of a pressure operated microphone, one tries to avoid this trouble by determining the pressure calibration by the resonant tube[1] or thermophone methods and by calculating the increase in sensitivity due to reflection from the microphone, the difficulty, if not impossibility, of making this calculation rigidly for practical forms of microphone is encountered.

We have developed a new technique of calibration by substitution in the free field, using a search tube of small diameter connected to a condenser microphone. The free space calibration of this search tube is obtained by inserting its open end through a rubber bush in one end of a closed resonant tube and adjusting its position until it is one or more half wave-lengths from the bush, that is, until it is at a pressure maximum other than those occurring at the two ends of the resonant tube. The search tube is then in a standing wave, which is conveniently measured by a Rayleigh disk suspended at the centre of the resonant tube. We have shown experimentally that the response of the search tube microphone is dependent only on the acoustic pressure at its mouth and is independent of the diameter of the resonant tube so long as this is large compared with the diameter of the search tube. We have been unable to detect any distortion of a sound field from a loud speaker in an absorbent test room due to the presence of the search tube, so it may be used to explore the field before and after the insertion of the microphone to be calibrated. If this microphone has had a pressure calibration in the resonant tube, the increased sensitivity due to reflection can be deduced. A check on this increase is obtained by a comparison of the explorations of the field with and without the microphone present. This has been done and the variation of the '2 : 1 effect' with frequency investigated.

The matter will be dealt with in a paper in the near future.

A. J. KING.
C. R. MAGUIRE.

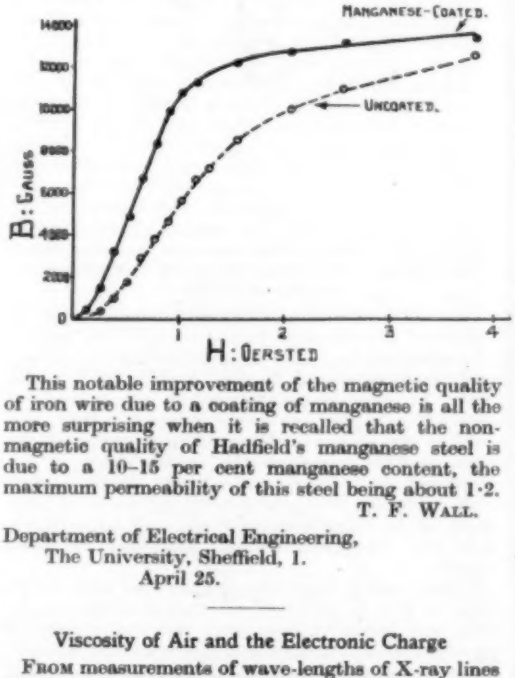
Research Department,
Metropolitan-Vickers Electrical Co., Ltd.,
Trafford Park, Manchester, 17.
May 9.

[1] Churcher, B. G. and King, A. J., *J. Inst. Elec. Eng.*, **68**, 97 (1930).

Effect of Manganese Coating on the Magnetic Quality of Iron Wire

A LENGTH of Armco iron wire was heated in hydrogen at about 1320° C. until a condition of maximum permeability was reached. The magnetization curve was then obtained (broken line curve in the accompanying graph).

Through the courtesy of Mr. Kenneth Gray, of Messrs. Mellowes and Co., a sample of the same consignment of Armco iron wire was sprayed with a coating of pure manganese powder to a thickness of about 0·002 in. This sample was then heated in hydrogen at about 1320° C. until a condition of maximum permeability was reached. The magnetization curve was then obtained (full line curve in the graph).



This notable improvement of the magnetic quality of iron wire due to a coating of manganese is all the more surprising when it is recalled that the non-magnetic quality of Hadfield's manganese steel is due to a 10–15 per cent manganese content, the maximum permeability of this steel being about 1·2.

T. F. WALL.

Department of Electrical Engineering,
The University, Sheffield, 1.
April 25.

Viscosity of Air and the Electronic Charge

FROM measurements of wave-lengths of X-ray lines with ruled grating and from the Bragg angles of reflections from crystals, it is possible to compute the magnitude of the electronic charge. The value thus obtained by Bearden[1] and Bäcklin[2] is $4{\cdot}807 \times 10^{-10}$ E.S.U., which is considerably higher than Birge's[3] best estimate of Millikan's oil drop value of electronic charge $(4{\cdot}770 \pm 0{\cdot}005) \times 10^{-10}$ E.S.U.

Millikan has in his own experiment[4] assumed a value for the viscosity of air at 23° C. of $(1822{\cdot}6 \pm 0{\cdot}04) \times 10^{-7}$ c.g.s. units, which is based only on the observations of Harrington[5].

Various experimenters have measured the viscosity of air, obtaining results varying from 1820×10^{-7} to 1850×10^{-7}. In view of the importance of an accurate knowledge of the coefficient of viscosity, we have carried out an investigation on viscosity from flow through capillary tubes. For the purpose of measuring instantaneous values of pressures, a method based on the counting of interference fringes originally adopted by Wagstaff[6] was employed with improvements. Five different capillary tubes were used and various necessary corrections were applied. The final value of viscosity of dry air at 23° C. obtained by us is $(1833{\cdot}3 \pm 2{\cdot}1) \times 10^{-7}$ c.g.s. units, while the increase per degree centigrade is $4{\cdot}95 \times 10^{-7}$ c.g.s. units. Our value is essentially close to Kellström's[7] value $(1834{\cdot}9 \pm 2{\cdot}7) \times 10^{-7}$ and also to Bond's[8] value $(1834{\cdot}7 \pm 0{\cdot}8) \times 10^{-7}$. Rigden[9] has reported a slightly lower value.

If our value of viscosity of air be substituted in Millikan's oil drop experiment, $e = (4{\cdot}811 \pm 0{\cdot}009) \times 10^{-10}$ E.S.U., which agrees with the X-ray value of $e = 4{\cdot}807 \times 10^{-10}$ within the source of experimental error.

A detailed account of the work will be published elsewhere.

G. B. BANERJEA.
B. PATTANAIK.

Department of Physics,
Ravenshaw College,
Cuttack.

[1] Bearden, *Phys. Rev.*, **37**, 1210 (1931).
[2] Bäcklin, *Z. Phys.*, **93**, 450 (1934).
[3] Birge, *Phys. Rev.*, Supp., **1**, 1 (1929).
[4] Millikan, *Phil. Mag.*, **34** (1917).
[5] Harrington, *Phys. Rev.*, **8**, 738 (1916).
[6] Wagstaff, *Phil. Mag.*, **45**, 84 (1923).
[7] Kellström, *Phil. Mag.*, **23**, 250 (1937).
[8] Bond, *Proc. Phys. Soc.*, **49**, 206 (1937).
[9] Rigden, NATURE, **141**, 82 (Jan. 8, 1938).

Life-History of the Salmon (*Salmo salar* L.)

IN a recent communication, published in *The Times* of March 26, we appealed to British and Irish boards of salmon fisheries for help in obtaining material for the study of the sexual phases in salmon parr; we now wish to appeal to all European bodies who could send us samples of either salmon parr or salmon smolts five inches in length or more.

We have found that a ripe and almost certainly functional male phase is attained normally in most—and possibly all—male *Salmo salar* from the Welsh and Cheshire Dee before they migrate to the sea as smolts[1]. To obtain evidence of the functionality of this phase it is necessary to examine parr or smolts in the post-breeding season. Material from the Welsh Dee has confirmed the inference that the young males spawn in this river; a full account of this work will be published elsewhere later. It is, however, desirable to investigate the problem throughout the geographical range of the salmon to ascertain whether the phase is constant under widely different environmental conditions.

It is conceivable that breeding habits may vary in this fish with extremes of habitat. The results from the Dee indicate that spent males may behave differently from the mature females of the same age, whence it is advisable to sample different groups or shoals of parr or smolts. Such samples from European countries would be gratefully received and gladly acknowledged by us at the address given below, and reasonable expenses paid.

J. H. ORTON.
J. W. JONES.

Department of Zoology,
University of Liverpool.

[1] Orton, J. H., Jones, J. W., and King, G. M., *Proc. Roy. Soc.*, B, **125**, No. 838 (March 1938).

Revision of Al I Terms

IN the course of a study of the proper co-ordination of the AlH spectral terms to the Al + H atomic combinations[1], some doubts arose as to the correctness of Lansing's analysis[2] of the Al I lines in the region 3050–3070 A. Spectrograms of an interrupted aluminium arc were taken with the large concave grating of this Institute. The measurement of the seven lines (three of which were attributed by Lansing, on the basis of wrong measurements, to an $sp^2\ ^2D \rightarrow s^2p\ ^2P$ transition) revealed, first, that no one wave-number difference is equal to the separation of the $s^2p\ ^2P$ ground state of Al, and secondly, that all the seven observable lines can be explained at once by a $3s3p4s\ ^4P \rightarrow 3s3p^2\ ^4P$ transition. This explanation is supported by the analogous term-combinations in the isoelectronic sequence Al I, Si II, etc.[3]; the separations of the multiplet components and relative positions of the two ^4P terms of Al can be calculated to a rather good approximation from the positions and separations of the related terms. Preliminary results of Zeeman effect experiments on the strongest of the seven lines involved also confirm the $^4P \rightarrow {}^4P$ explanation.

The classification, wave-numbers and estimated intensities of the analysed group of seven Al I lines are given in the following table:

		$3s3p4s\ ^4P$		
		$j = 5/2$	$j = 3/2$	$j = 1/2$
$3s3p^2\ ^4P$	$j = 5/2$	32700·6 (10)	32604·6 (8)	—
	$j = 3/2$	32776·5 (6)	32680·4 (2)	32624·1 (3)
	$j = 1/2$	—	32727·1 (4)	32671·0 (0)

Since the incorrect previous assignment has been quoted in books of reference (such as "Atomic Energy States" by Bacher and Goudsmit), a revision, that is, the dropping of the term-value of $3s3p^2\ ^2D$, seems to be necessary. One gains, however, a more uniform co-ordination (in the sense already outlined[1]) of the hydride and deuteride molecular terms of the elements in the third column of the Periodic Table with the proper atomic term-combinations.

R. SCHMID.
L. GERÖ.
KATALIN LÖRINCZI.
G. NEU.

Physical Institute, Royal Hungarian
University for Technical and Economic
Sciences, Budapest.
April 21.

[1] Schmid and Gerö, *Naturwiss.*, **26**, 108 (1938).
[2] Lansing, *Phys. Rev.*, **34**, 597 (1929).
[3] Beckman, Anna, Diss., Uppsala (1937).

An Optical Illusion

In the course of some cinematographic tests, I observed a visual effect which may be of some interest to readers of NATURE and is probably open to a ready explanation.

A cage consisting of two bright wire rings crossing at right angles and about 8 in. in diameter was rotated about its polar axis, at varying speeds. The object was to produce a bubble-like appearance on a film. During rotation three optically black lines appeared, one apparently reaching from pole to pole in a straight line and the other two stretching from pole to pole in right and left hand curves. It is obvious that these dark lines are caused by the passage of the parallels of longitude across each other; thus the vertical line appears when one circle is edge on to the line of sight, and the curved lines when rotation through 45° from that position has occurred.

I should value an explanation of the cause of the lines. It is probably needless to add that they do not show on the cinematograph film. The lines are seen quite distinctly at low speeds—even oscillating the cage with the fingers—and in any light. A spot light and dark background gives the best effect.

LOUGH PENDRED.

28 Essex Street, Strand,
London, W.C.2.
May 16.

Points from Foregoing Letters

S. Kownacki and J. A. Ratcliffe outline a method for investigating 'electron-inertia' effects in thermionic tubes. They point out that if positive ions of atomic mass are used instead of electrons, the frequencies involved are very much smaller and more manageable. They have investigated some 'electron-resonance' effects with tubes in which positive ion emitters were used, and the frequencies involved were about 5×10^6 and 10^6 c./sec. when cæsium and lithium ions respectively were used.

Sir Arthur Keith, after examining a cast of the South African 'Florisbad' skull, concludes that it is an important evolutionary link indicating that South Africa, like Java, has been an independent centre of development from a sub-human form to the modern Bushman and Hottentot.

Prof. C. N. Hinshelwood differs strongly from Prof. Travers in the interpretation of the kinetics of certain gaseous organic reactions, and gives as an example data obtained by Seddon and Travers for the decomposition of acetaldehyde at 400°, from which he would draw quite different conclusions.

An electron-counting device based upon the secondary emission principle has been constructed by Prof. Z. Bay. It does not involve cooling in liquid air to suppress thermal ionization, but utilizes a very thin layer of barium oxide on a nickel base with a high 'work function', and a ten-stage multiplier which gives a ten thousand fold increase. The instrument has a resolving ability which greatly surpasses that of the gas-filled counters.

When negative ions are formed at metal surfaces by bombardment with positive ions, the resulting negative ions need not be of the same element as the bombarding positive ions, according to Dr. F. L. Arnot and C. Beckett. As an example, they describe experiments showing that positive mercury ions may produce negative oxygen ions.

The exchange of hydrogen atoms between secondary alcohols and ketones, or similar compounds, under the influence of ultra-violet light (a reaction important also in the photochemistry of ergosterol) has been investigated by Ch. Weizmann, Y. Hirshberg and Dr. E. Bergmann. They consider that it comes about through the activation of the carbonyl group, CO, which afterwards reacts with the secondary alcohol group, splitting the C—H bond, and giving two free radicals which may either join together or be stabilized by a second oxidation-reduction process.

The fact that mitoses occur in follicles of rats some time after hypophysectomy leads Dr. J. Freud to the view that follicular growth is perhaps only indirectly dependent on the pituitary. It is assumed that the pituitary produces a hormone causing growth of eggs. When the egg volume reaches twenty-five times the original, the production of a hormone by the egg itself becomes apparent by the mitogenic response of the follicle. The folliculogenic hormone is therefore not of pituitary origin but is produced in the egg-cell.

Histamine hydrochloride injected into white mice is found by Dr. F. Ellinger to decrease the body weight in the same way as irradiation with ultra-violet light. He considers that histamine exerts its action by stimulating the thyroid gland.

Several stages in the development of the giant salivary gland nuclei in the fruit fly, *D. repleta*, are described and illustrated by S. L. Frolova. She finds that all resting nuclei in the larvæ and imago of *Drosophila* are alike and do not differ from the spireme-like salivary nuclei.

From new determinations of the true specific heat of potassium and lithium, together with previously known values for lithium and sodium, L. G. Carpenter, T. F. Harle and C. J. Steward have drawn curves showing that the abnormal rise of specific heat, extending over a considerable range below the melting point, is common to these three alkali elements.

A new technique for the calibration of microphones, by substituting in the 'free field' a search tube of small diameter connected to a condenser microphone, is described by A. J. King and C. R. Maguire.

Dr. T. F. Wall finds that the magnetic permeability of an iron wire is notably increased when covered with a thin coating (about 0·002 in.) of manganese.

A redetermination of the viscosity of air by Dr. G. B. Banerjea and B. Pattanaik gives a value of $1{\cdot}833{\cdot}3 \times 10^7$ c.g.s. units, which when introduced in Millikan's data from his oil-drop experiment, gives a value of 4·811 for the electronic charge, in close agreement with the value obtained from X-ray experiments.

Dr. R. Schmid and collaborators have identified in the Al I spectrum a $^4P \rightarrow {}^4P$ transition, which necessitates the dropping of a previously accepted ^3D term.

Research Items

Race and Language in India

WITH a view to possible light on the problem of race and language, Dr. D. N. Majumdar has investigated the physical relationship of certain Austric-speaking tribes of India with special reference to measurements of Hos and Saoras made by himself and others (*Proc. Ind. Acad. Sciences*, **7**, 1; 1938). The relevant questions to be answered are: (1) Whether the Austric-speaking tribes in India and more particularly the Munda-speaking groups represent the same racial type; (2) Is there any racial difference between the Mundas and the Dravidian-speaking group? (3) Are the Hos and Mundas more variable than the Sonthal and Bhumij? Taking first the comparison of the Ho series from the Kolhan with the Mundas and Bhumij, two neighbouring groups, believed to be of the same racial stock, a comparison of the mean measurements shows that while there are quite marked differences between the three groups, the only significant difference between Hos and Mundas is in stature, while between Hos and Bhumij there is no evidence of difference except for the nasal measurements, which in the Mundas and Bhumij are of doubtful accuracy. Otherwise it is to be concluded that the three groups are of the same or similar origins. Comparison of the Saoras with the Hos and with the Mundas and Bhumij confirms the general belief that the Saoras are of an entirely different stock. Twelve comparable characters show in their means a significant difference in seven, especially marked in nasal length and bizygomatic breadth; but it is of interest to note that all four types are almost identical as to cephalic index. In regard to differences from the high caste Brahmins and Kayasthas, and the tribal Khasis of Assam, of ten characters, both absolute and indical, significant differences exist between the Hos and Saoras and the caste groups—from the Brahmins in seven and from the Kayasthas in eight, these being interpreted as a racial difference. Between Hos and Khasis there are significant differences in six characters, the difference of the Saoras and Khasis being approximately the same.

Genetics of Schoolboys

IN a study of the stature of 2,500 schoolboys in Sheffield between the ages of 5 and 17 years, Dr. M. A. MacConaill (*Ann. Eugenics*, **8**, 117) divides them into three classes: blond, brunet and heterochrome; the blonds having blue eyes and fair hair, brunets brown eyes and dark hair, heterochromes all other combinations of eye and hair colour. The heterochromes were found to be significantly shorter than the blond and brunet groups at all ages except during puberty. They were also more variable than the blonds and brunets. In explanation of these significant results, it is suggested that the heterochromes are more heterozygous than the other two types. In an earlier paper by MacConaill and Ralphs in the same journal (**7**; 218) a study of the post-natal development of eye and hair colour was made in the same group of schoolboys. The type called leucochrome, with blue eyes and blond hair, showed a steady fall in frequency throughout the age period from 5 to 21 years. All other types were called allochrome, and were divided into brunet, heterochrome and xanthochrome (pure blonds, other than leucochrome). The leucochrome is the type of infancy, from which all other types gradually arise through development of pigment. They fall to a steady ratio of 17 per 1,000 at the age of puberty. It is suggested that the leucochrome type is essentially a Mendelian recessive, the delayed development of pigment in the other types being a manifestation of delayed dominance, as in some animals.

Removal of Poison Glands of Rattlesnakes

PROF. JOHN TAIT of McGill University describes an operation for the surgical removal of the poison glands of rattlesnakes, devised to make the animals more amenable to physiological experimentation (*Copeia*, March 1938, p. 10). The snake is anæsthetized in a glass box containing dilute chloroform vapour and the operation, which is described in detail, occupies at top-speed twenty-one minutes, the depth of anæsthesia being gauged carefully throughout the process. The removal of the glands alters the shape of the head, which becomes narrow like that of poisonous colubrine or innocuous snakes. It has no effect upon the temper or health of the snake nor does it affect the maintenance or successional replacement of the fangs; fang-growth and replacement being apparently controlled independently of the associated poison glands. Another point of interest was that in one or two of the early trials the poison sac was perforated and venom flowed freely into the open wound; the poison was swabbed away so far as possible, but in no case did the snake show any harm from being deluged with its own poison. The procedure devised for deglanding should prove a useful advance, for it produces a wound that heals readily, no case of lethal sepsis having been recorded in operations on some hundred and twenty snakes. On the other hand, the old method of removing the fixed and reserve fangs usually resulted in an infection of the mouth, which was intractable to disinfection and resulted in death.

Development of Compound Eyes

AN important work upon the morphogenesis of the compound eyes of arthropods, by Francis Bernard, has been issued as Supplement 22 to *Bull. Biol. France et Belgique* (1937). In spite of differences in the minute structure of the elements of compound eyes, there is a common plan in their development and growth. Thus the development of parts follows a regular succession—optic ganglia, retina and peripheral pigmentary cells, cornea and crystalline lens. So in the growth of compound eyes—a subject little studied hitherto—Bernard finds that increase in size is due to additions of new elements or ommatidia formed in a lateral hypodermic zone. The elements do not reach the surface and become functional until two or three stages after the cell-divisions which originate them. The additional facets grow in regularly rhythmic series parallel with the stages of moulting, except in the crab, *Macropodia rostrata*, where phases of arrested development have been observed. Finally, the author devotes a chapter to the study of the structure of reduced compound

eyes, adding twenty new examples from his own observation. Reduction in the adult eyes is due to three distinct processes: simple atrophy or arrest of normal development as in the retina of all arthropods studied and in the crystalline cones of insects; hypertrophy of certain secretions, as in the rhabdome of all arthropods, and the cones of Crustacea; and degeneration in the course of larval life, as in the optic ganglia of certain parasitic Crustacea. This comprehensive study should facilitate new researches on the subject of morphogenesis in compound eyes.

Dextrality in *Limnæa peregra*

THE inheritance of dextrality and sinistrality in snail shells has been shown to be a phenomenon of considerable complexity with several peculiar features. The problem has been carried further in a long paper by Capt. C. Diver and I. Andersson-Kottö (*J. Genetics*, 35, No. 3). It has already been shown in *Limnæa peregra* that four types of broods exist: *A* broods, all dextral; *K* broods, all sinistral; *E* broods, sinistral with a few dextrals; and *F* broods, dextral with a few sinistrals. Sinistrality is also a simple recessive to dextrality, but owing to the nature of the character, it is determined in the egg before fertilization by the joint action of the genes in the zygotic constitution of the parent. The constitution of an individual is therefore determined by the brood it produces, and segregation is only visible in F_2. *E* broods are genetically sinistral, but contain up to 20 per cent of phenotypic dextrals, the percentage varying in different strains. On the other hand, the sinistrals produced in *F* broods are usually genotypic as well as phenotypic. These and many other results of breeding experiments are explained on the hypothesis that *E* broods are the product of a series of modifying genes, some stronger in effect than others, which convert a homogeneous sinistral brood into a mixture. They follow the system of delayed inheritance, like the principal gene. The *F* broods are probably of different types, some of them due to a direct mutation from dextrality to sinistrality.

Action of One Plant Upon Another

A SHORT paper by Prof. F. E. Weiss (*J. Roy. Hort. Soc.*, 63, Pt. 4, 166–169, April 1938) directs attention to an interesting trend of modern botanical research, namely, the influence of one plant upon another. Relations between stock and scion, and between two symbionts are obvious instances, but there are also less patent influences. Prof. Weiss considered the work of Gurwitsch on mitogenetic rays, where the proximity of one plant has been held to induce cell division in another organism. Toxic substances released from one plant may inhibit the growth of another, and it is probable that the grass under the trees in some orchards has a deleterious effect upon the fruit crop. Ripening apples liberate a substance, probably ethylene, which can assist the maturation of later varieties, and also, according to Gane and Smith, can affect the germination of peas deleteriously. The late Prof. Molisch had experimented further in this direction, and found that very light doses of apple vapour assisted the germination of many kinds of seeds, where heavier applications were harmful. Leaf-fall in privet, elder and other plants was induced by the emanations from apples, which also stimulated the rooting of poplar and willow cuttings. Vapours from pot-bound roots of *Melaleuca squamea* and *Acacia verticillata* accelerated the growth of vetch seedlings. It is obvious that more research is desirable, but the results collected by Prof. Weiss offer a most attractive field for future investigation.

A Virus and its Insect Vector

SOME ingenious experiments upon the relations between Hyoscyamus virus 3 and the aphid *Myzus persicæ* are described in a recent paper by Mrs. M. A. Watson (*Proc. Roy. Soc. B.*, 125, 144–170, March 1938). Relations between a virus and its insect vector are often very close. The paper under review shows that the aphid can transmit the virus much more easily if made to fast before feeding upon infectious material. Previously fasted aphids, when fed for one hour on healthy plants before their diet was changed to infectious material, however, transmitted the disease no better than unfasted ones. Unfastep aphids quickly lost their power of infecting, whilst fasted insects retained this ability for a longer time. A consideration of these points leads to the supposition that the virus is inactivated by some substance acting during the digestion of food. Trypsin is known to inactivate the virus *in vitro*, and since this enzyme is not produced when an aphid fasts, the assumption that it acts as a substance toxic to the virus fits all the above facts. It is not yet clear, however, how such inactivation by a stomach enzyme could exert an effect through the salivary glands and proboscis, which are regarded as the organs of re-infection.

New Map of Graham Land

THE map of Graham Land, Antarctica, was considerably changed as the result of Sir H. Wilkin's flight ten years ago. Now as the result of the air and sledge journeys of the British Graham Land Expedition under Mr. J. Rymill, some of the older features of the map have been reinstated but with modification. The new map appears in the *Geographical Journal* of April and May accompanying an article by Mr. Rymill on the work of the expedition. The peninsularity of this part of Antarctica is again established. Casey Channel and Stefansson Strait disappear. Scripps Island, in about lat. 70° S., is a mountainous area of the mainland. But a remarkable new channel appears on the map. King George VI Sound, twelve to thirty miles in width, stretches for more than two hundred miles between the mainland of Antarctica and Alexander I Island. The latter is much increased in size and appears to be linked by shelf ice, probably of glacier origin, with Charcot Island farther west. The sound is filled with ice and was explored by sledge and aeroplane. At the most southerly point reached in about lat. 72° S. there was no sign of a channel to the east. The sound turned in a south-south-west direction and widened considerably, suggesting that it opened into a wide bay south of Alexander I. Island. The lack of a good route eastward towards the Weddell Sea prevented the exploration of the inaccessible western coast of that sea, which had been one of the main objectives of the expedition.

Cyclone Season 1934-35 at Mauritius

No. 17 of Miscellaneous Publications of the Royal Alfred Observatory by M. Herchenroder, entitled "The Cyclone Season 1934–35 at Mauritius", contains charts and descriptions relating to the eight cyclones

of that season with some reference also to five minor disturbances. The season was not a remarkable one, the number of cyclones and minor disturbances being the same as in 1933–34, except for the absence of cyclones around Mauritius and Madagascar in March and for the lack of evidence of any such storm throughout the entire season around the Cocos Keeling Islands. The author, in reference to a common notion that tropical cyclones are not accompanied by high pressure systems as is the case with intense temperate depressions, notes that five out of the eight here described disproved this notion in a striking manner. Four of these formed near Madagascar, and the accompanying anticyclone was easily identified with the aid of the South African weather reports. The incursion of this anticyclone north-eastwards into lower latitudes with the invasion of cooler air from higher latitudes appeared to be a preliminary event incidental to the formation of the tropical cyclone centre. It is suggested that perhaps only lack of information prevents a similar state of affairs from being demonstrable in the case of the formation of tropical cyclones in other parts of the South Indian Ocean. This lack of information, it is suggested, is unlikely ever to be got over by reports from ships alone. Attention is directed also, in this discussion, to another matter in connexion with the development of these cyclones, and that is the growing belief among observers that a necessary condition for such development is the extension of the cold easterly or south-easterly current of the accompanying anticyclone above the equatorial current, a belief referred to, for example, in the meteorological report of the Madagascar Weather Service for March 1935.

Effect of the Surrounding Medium on Fracture in Solids

P. Rehbinder and E. Wenström (*Bull. Acad. Sci. U.R.S.S.*, 548; 1937) have shown in previous publications that 'brittle fracture' of solid bodies becomes easier on immersion in a suitable liquid, and that the surface hardness is reduced by this immersion. This phenomenon is connected with the reduction in surface energy produced by immersion. In the present work they show that the *plastic* fracture of wires stretched under a non-polar liquid (pure hydrocarbon oil) is greatly influenced by the addition of polar substances. For example, the time during which plastic flow takes place before fracture in lead may be reduced by a factor of 30–60 by the addition of 0·001–0·005 per cent of $C_{25}H_{51}COOH$. This effect is described as an 'internal lubrication' of the metal, and it is suggested that it plays an important part in the action of lubricated cutting tools.

Absorption of Fast Electrons

A. J. Ruhlig and H. R. Crane (*Phys. Rev.*, **53**, 618; 1938) have extended the work of Crane on the energy losses of high-energy electrons in thin lead sheets. The particles studied included a group 0·35–1·35 M.e.v. from radioactive phosphorus and a group up to 17 M.e.v. produced by the $Li + {}^1H$ gamma-radiation. In the lower energy region, the losses due to radiation are negligible according to the Bethe–Heitler theory, and the loss is due almost entirely to ionization processes. The experimental value for the energy loss is about three times that given by the theory of Bloch, and shows an increase on going from 0·5 to 1 M.e.v. which is difficult to understand. In the high-energy group the energy loss is primarily radiative, and follows theory in a general way. The experimental values are appreciably higher than the theoretical.

Accuracy of Parallaxes

In a recent paper, Prof. W. J. Luyten shows that parallaxes determined from spectral class and proper motion possess a high *individual* accuracy, contrary to the generally accepted view that they are useful only for statistical investigation (*Mon. Not. Roy. Astro. Soc.*, **98**, 5, March 1938). In 1923, the author published the spectra and hypothetical parallaxes for 100 stars of large proper motion, and in 1924 he published a list of hypothetical parallaxes for bright stars in the southern hemisphere. When these lists appeared, only a small proportion of the stars had known trigonometric parallaxes, but these have been determined for practically all of them since. Two tables show the comparison between parallaxes predicted and those determined trigonometrically, and the agreement is as good as we find between two different series of trigonometric parallaxes. There are a few cases where considerable discrepancies appear, but it is suggested that the spectral class used is wrong for three stars in the first list, and in the second list, taken from *H.C.*, 251, 1924, p Eridani, which shows a fairly large discrepancy, is an exceptional star, having a tangential velocity of only 8 km./sec., and a much larger mass than the mean for its spectral class. The author is of opinion that if accurate spectral classes, magnitudes and proper motions were available, it would be possible to predict the parallax of a star with a mean error of 23 per cent, corresponding to mag. 0·7 in the resulting absolute magnitudes.

Czech Astronomical Observations

Memoirs Nos. 3, 4 and 5 recently published by the Czech Astronomical Association at Prague give, respectively, results of solar observations, observations of variable stars, and the results of the expedition to Sara, U.S.S.R., to observe the total solar eclipse of June 19, 1936. The solar observations, which were carried out by nine of the Society's members, express the sun's activity during 1935 as given by sunspots, faculæ and prominences. Using a direct-vision spectroscope and the $H\alpha$ line of the solar spectrum, the height of the chromosphere was also systematically determined around the disk. The variable stars discussed are RY Bootis, ST Camelopardalis and R Scuti, which have been regularly observed by members of the Society since 1930. R Scuti is shown to have a variability which places it in the RV Tauri type, that is, an irregular variable resembling to some extent a Cepheid, with a range of about two magnitudes and a variability in spectrum. The solar eclipse expedition included in its work (*a*) a study of the height and intensity of the chromospheric lines of the flash spectrum using the moving plate method; (*b*) the distribution of radiation at 0·56 μ over the solar disk; (*c*) the sky spectrum during totality; and (*d*) a photometric study of the corona in the infra-red. The results are a useful quota to knowledge of the sun obtained under the rare conditions of a total eclipse, whilst the intensity determination of radiation across the disk affords an interesting comparison with the extensive observations made by Abbot some years ago without an eclipse.

The National Physical Laboratory

Report for 1937

THE report of the work carried out at the National Physical Laboratory during the year 1937 shows marked activity in each of the seven departments into which its field of operations has been divided and also in connexion with the special work of the William Froude Laboratory on the propulsion of ships*. One aspect of the report which should not be lost sight of in its perusal is the indication, which is implicit on practically every page, of the value of the assistance it can give to industry both in the results of its own wide programme of research and also in its readiness to undertake special investigations on behalf of manufacturers. This should be more widely known and appreciated as the scope of their work and the amount of scientific data accumulated place the staff in a quite unique position to offer advice and help.

In the Physics Department, investigations on the thermal conductivity of several gases, liquids, and solids have been proceeding. These have included a survey of published data regarding the thermal and electrical conductivities of iron and steel with results which have indicated the direction of the further investigations which are being undertaken. Research has been carried on in connexion with the thermal insulation of buildings, refrigeration, and properties of metals at high temperatures. The investigation which has been proceeding on the International Temperature Scale is now completed and the report summarizes its results in relation to the standard platinum, 10 per cent rhodium-platinum thermocouple used in the region between 660° and 1063° C. and the conditions which limit its accuracy. The Radiology Section, among many other investigations, continued the study referred to in the previous report on the fatigue failure of metals. The examination of annealed mild steel has been completed and has shown that when the applied stress is such as ultimately to produce fracture, severe fragmentation of the crystallites occurs and increases up to the point of fracture. Where fragmentation has already been carried to an advanced stage by severe cold work, it has been found that, provided the stress applied is below that necessary to produce eventual fracture, no further structural change occurs.

The value of the work of the Electrical Department has received recognition by the acceptance of the results of the investigations on units and standards. Also a new clock has been devised and constructed at the Laboratory which is of such a high degree of accuracy that its error is but a fraction of a second in a year. This has been attained by mounting the quartz ring oscillator on three fixed points as supports located at the nodes of the vibrating ring. This provides a more robust form of construction which makes it practically independent of mechanical vibrations and changes of level and so constitutes it a practical instrument for use in astronomical observatories, in radio-telegraphy, etc. In addition to the clock made for the National Physical Laboratory, one has also been made for the Royal Observatory, Greenwich, and two are being made for the Australian Government for use in connexion with radio communication. The work on visual characteristics has led to a number of interesting results, some of which are of direct importance in photometry and in practical problems of lighting. A paper published by the Department gives a full account of the work done on non-foveal vision, the visual conditions which supervene when the sensitivity of the eye is reduced by the presence of a source of high intensity in the field of view. In relation to the detection of objects in an artificially lighted street, the relative merits of lights of different spectral distributions have been studied. This work, in progress, is on the lines of ascertaining the average time taken by different observers to detect models of a person or a dog introduced into a film projection under conditions simulating those existing in typical carriageways.

Among the new researches commenced during the year in the Engineering Department is an investigation on the welded construction of pressure vessels. Developments in chemical engineering have led to a big increase in the use of liquefied gases, and for transport it is of considerable importance that, without sacrificing the necessary margin of safety, any improvements which result in reduction of weight should be investigated. Other new researches deal with the surface finish of steel strip—a matter of special importance to the aircraft industry—experimental work on the properties, in particular the variation of liquid density and of vapour pressure with change of temperature, of the gases propane and butane, and also an investigation into the silencing of motor cycles.

The use of cast materials for engine crankshafts is a recent unexpected development. In co-operation with the Institution of Automobile Engineers, the British Cast Iron Research Association and five interested firms, one steel material and four irons were fully investigated and the conclusion of the inquiry is recorded. These materials were subjected to static, hardness, and impact tests and also to a comprehensive series of fatigue tests involving bending, torsion, and combined bending and torsion. Metallurgical examination included chemical analysis and microstructure. Under the combined fatigue stresses these cast metals exhibited characteristics sharply dividing them from the ductile wrought steels. The results have been published separately and give a lead as to the wide possibilities of application of these cast metals in the field of engineering.

The Aerodynamics Department has been working at high pressure particularly in connexion with development work on new types of aircraft. The analysis of turbulent flow by determination of the turbulent energy in various frequency bands has been continued. So far as this work has gone, it has proved of exceptional interest, and the agreement found with the modern theory of turbulence indicates that there is every hope of understanding turbulent

* The National Physical Laboratory: Report for the year 1937. Pp. iv+150. (London: H.M. Stationery Office, 1938.) 2s. 6d. net.

phenomena much more fully in the near future. Airscrew research has been carried out in co-operation with the Royal Aircraft Establishment on full-scale airscrew performance in the 24-ft. wind tunnel there. On the subject of 'flutter derivatives' it is hoped that some light will be thrown by the results of measurements of the instantaneous air forces acting on oscillating aerofoils by an apparatus which is under development.

Among the researches carried out at the William Froude Laboratory was one for the Herring Industry Board and the Coal Utilisation Council concerning the herring drifter, and it was shown that the form of hull in use at present can be so improved as to give a 40 per cent reduction in power for a speed of 9 knots, with a definite improvement in seaworthiness as shown by tests in rough water. In the Alfred Yarrow Tank it is proposed to replace the wave making apparatus which after twenty-one years service is badly deteriorated. The new equipment will be of 12 b.h.p. instead of 7 b.h.p. and will, by being run from a separate electric supply, be able to give a longer test. Numerous researches have been carried out on screw propellers and in several cases the results have been published. Other researches have been in connexion with the shape of ship bows, natural frequency relative to ship vibration, and the effects of helm action on propulsive efficiency. For a special tug, a programme of research on a pair of paddle wheels will shortly be put into operation.

These are but a selection of the activities which are treated in the report, in which particulars of the several papers published by each of the departments are given.

Nutritional Surveys of Inland Australia

Problems of Child Nutrition

FEW of the various national nutrition committees appointed following the recommendations of the League of Nations have brought more enthusiasm and resource to their task than the Commonwealth of Australia's Advisory Council on Nutrition. Its recently published fourth report provides ample evidence not only of painstaking endeavour to arrive at a true assessment of the nutritional state of white children living in urban and rural districts of Australia, but also of the need for devising means whereby the revealed deficiencies may be corrected.

Dr. F. W. Clements, who is engaged on a three-year programme of surveys designed to cover a large section of the interior mainly beyond the railway system, presents his preliminary findings for certain inland areas of Queensland, New South Wales and Victoria. Of the children examined in New South Wales, 23·7 per cent showed signs of unsatisfactory nutrition; in Queensland the figure was 18·8 per cent, and in Victoria, 13·3 per cent. Amongst pre-school children of Melbourne examined during the same period, the corresponding percentage was as high as 21·7. Although the numbers examined were necessarily small, there is no reason to suppose that they were in any way selected or unrepresentative of the prevailing conditions. The Council, therefore, finds itself faced with two distinct problems, the undernourished child of the city, and the undernourished child of the remoter outback districts.

Chief consideration has been given to the occurrence of rickets and nutritional anæmia, the incidence of both of which was found to be considerable. In Victoria, for example, a high incidence of anæmia among pre-school children was discovered, boys apparently being more prone to develop the symptoms than girls; and the conclusion is reached that the average hæmoglobin level in children of the Queensland outback is distinctly lower than that of children living in the cities of Scotland. A careful watch for scurvy was unrewarded save for one doubtful case of hypertrophic gingivitis. That fruit is rare may be gathered from one of those touches of significant observation which make this whole report of unusual interest. At a backwood's race meeting the author purchased from a wandering salesman a dozen small shrivelled apples at a cost of 2½*d.* each. Fresh tomatoes are also a luxury, but potatoes and pumpkin are largely eaten. Further inquiry into the circumstances of those children found to be suffering from rickets, elicited the fact that they were accustomed to a low intake of protective foods, little milk and no cod liver oil. It is reported, too, that in several towns no milk is available for the feeding of children in infancy.

The section on the Mount Isa communities is perhaps the most interesting in the report. Here, two almost distinct towns have grown up around the Mount Isa lead-silver mines. At the mine site the enterprising company has built for its employees comfortable houses adequately planned and situated amid sylvan surroundings. Rent is reasonable, electricity is free, and many other advantages play an important part in maintaining a sense of citizenship. On the town side, on the other hand, are to be seen shacks improvised from carbide drums, kerosene tins and hessian, where a shiftless and improvident population has no incentive to maintain a decent standard of living. The following reflects the difference in condition, and it is to be noted that the parents of children suffering from rickets in the Mines School were all new arrivals to the district and had been long unemployed.

Deficiency Diseases	*Town School*	*Mines School*
Nutritional anæmia	12·0 per cent	3·4 per cent
Active Rickets	17·0 ,,	10·3 ,,
Chronic infections	4·0 ,,	1·7 ,,

In view of their importance and bearing on similar problems being investigated in other parts of the Empire, it is to be hoped that these Australian results will be placed on permanent record and be made easily available to all who are engaged on nutrition survey work.

International Conference for the Protection of the Fauna and Flora of Africa

THE Second International Conference for the Protection of the Fauna and Flora of Africa was opened by the Marquis of Dufferin and Ava, Parliamentary Under-Secretary of State for the Colonies, in the Moses Room of the House of Lords on May 24 and was attended by Government delegates of the Union of South Africa, Belgium, Great Britain and Northern Ireland, Egypt, France, Italy, Portugal and the Netherlands. The interests of the Anglo-Egyptian Sudan were represented by the United Kingdom and Egyptian delegations jointly. The main object of the Conference was the exchange of information and exploratory discussion preparatory to a further conference, which it is hoped to hold in 1939. The Earl of Onslow presided, and subsequent meetings were held on May 25 and 27. A committee of experts was appointed to draw up a list of suggestions for addition of further species to the Annex of the Convention.

It was announced that the Convention, signed in 1933, had been ratified by the United Kingdom and Belgium in respect of their African territories, and by the Union of South Africa, Egypt and the Sudan, and that it was hoped that France, Italy and Portugal would shortly be able to complete their ratifications. During the course of the meeting, the French delegate announced that he had just received information that the President of the French Republic was at that moment on the point of signing the ratification of France.

The proceedings opened by the submission of statements by delegates of action taken by their respective Governments since the signing of the Convention of 1933. The High Commissioner, Mr. C. T. te Water, on behalf of South Africa, stressed the necessity of arousing public interest and stimulating effort for the protection of wild life, and pointed out that international conferences such as the present one help greatly in bringing to the attention of the Governments concerned a subject of great national importance. He stated that his Government is continuing its policy of setting aside areas as game reserves and national parks, and since the Convention had come into force, further legislation has been promulgated for the preservation of fauna and flora. He alluded to the serious condition of the status of the mountain zebra (*Hippotogris zebra*), which is slowly dying out, and said that the matter is being given close consideration by the Government in order to secure measures for the adequate protection of the remaining herds, and that land is being acquired in various districts to this end. He also mentioned that the laws with regard to shooting game from motor-vehicles are very strictly carried out.

The Belgian delegation reported the creation of further national parks and stated that an important feature of the administration of these parks is the undertaking of systematic exploration of their fauna and flora, with special reference to the presence of disease, particularly parasitic disease, among the animals contained therein. The Government has taken measures for the protection of flora by setting up forest reserves in which special attention is given to the need for maintaining an adequate water supply.

Sir William Gowers, Senior Crown Agent for the Colonies, in presenting the report of the United Kingdom, directed attention to the great diversity of conditions in the fourteen territories concerned, and their difference in range of flora, fauna and density of population. The establishment of reserves is the policy of many Governments, but, while it is not regarded as incompatible with the principles of the Convention that a national park should be inhabited by natives, it is nevertheless regarded as important that the extent of native population should not be such as to interfere on one hand with the rights of the natives and on the other with the interests of game preservation. It has therefore been necessary to proceed with caution before definitely demarcating areas to be set aside as national parks. In pointing out the salient features of the report, Sir William Gowers mentioned the action being taken by the Tanganyika Government in establishing a national park on the Serengeti Plains, the steps taken by the Government of Nyasaland to set up a strict natural reserve in its territory, and the proposals under consideration for similar measures in Kenya, Nigeria and Sierra Leone.

Mr. F. B. Wright, Acting High Commissioner for Southern Rhodesia, reported the establishment of four game reserves and emphasized the interest felt by his Government for the objects of the Convention.

The Italian delegate stated that a special scientific mission has been sent to Italian East Africa to undertake a full survey of the position with regard to fauna and flora, and that the results of this investigation will be communicated for circulation.

The Portuguese delegate in presenting his report put forward two suggestions; first, that the question of surrounding animals by fire for hunting purposes should be examined again on account of the harm which this causes to fauna and flora; and secondly, that the possibility of taking measures for the partial and progressive modification of nomad native agriculture in African forests, in order to avoid the frequent and irregular clearing of important tracts of forest land, should be considered.

Statements were also given by the Egyptian, French and Anglo-Egyptian Sudan representatives, and the Netherlands delegate stated that his Government is greatly in favour of the Convention and has already applied Article 9 (concerning the traffic in 'trophies') to the Dutch East Indies.

A discussion on the subject of vermin took place and it was agreed that a positive definition of this is impracticable. Mr. te Water suggested that all Governments concerned be asked to furnish memoranda showing action taken in their respective territories to deal with this problem.

The question of (*a*) the exchange of information relating to infectious or contagious diseases of importance for the preservation of fauna or flora, or capable of affecting man as well as animals and, (*b*) the exchange between Governments of lists of persons known to have been guilty of persistent infringements of game regulations, were both examined at length, and the conclusion reached that with regard to both these questions a centralized system of exchange of

information is desirable, and that recommendations to this end should be put forward.

The report submitted by the Committee of Experts as to species recommended for inclusion in the Annex of the Convention on the occasion of its next revision was accepted. This contained proposals for the transference of certain species mentioned in the Annex from Class *B* to Class *A*, thereby affording them greater protection, and included among others the giant eland (*Taurotragus derbianus* (Gray)), black rhinoceros (*Rhinoceros bicornis* Linnæus) and secretary bird (*Sagittarius serpentarius serpentarius* Miller). The report also suggested the inclusion in both classes of certain species not heretofore included in the Annex. For inclusion in Class *A* were recommended among others the red wolf (*Canis simensis* (Ruppell)) and bongo (*Boocercus eurycerus* Ogilby) and the African peacock (*Afropava congensis* Chapin), so recently discovered to science, northern secretary bird (*Sagittarius serpentarius gambiensus* Ogilby), African broadbill (*Pseudocalyptomena graueri* Rothschild), Abyssinian ground chough (*Zavattariornis stresemanni* Holtoni), the flightless rail of Inaccessible Island (*Atlantisia rogersi* Lowe) and the so-called fishes of the grottoes of Thysville, African species of the genus *Cæcobarbus*. The last-named was the only case for the protection of fish brought to the attention of the Committee. The species being blind and of great zoological interest, it is the opinion of the Committee that it should receive as complete protection as possible.

The Conference agreed to recommend that a further meeting be held in London in 1939, concurrently with the meeting of the proposed International Conference for the Protection of Fauna and Flora of Tropical Asia and the Western Pacific. On the proposal of Mr. te Water, it was agreed to express the hope that it would be possible for the Governments concerned to arrange for the attachment to their respective delegations of officers in charge of the principal national parks, such as the Kruger National Park, and the Parc National Albert, whose expert advice would greatly assist the work of the Conference.

Impact of Chemistry on Biology

THE forty-second Bedson Lecture was delivered in the Chemistry Lecture Theatre, King's College, Newcastle-on-Tyne, on May 19 by Sir Henry Dale, who spoke on "The Impact of Chemistry on Biological Science". Sir Henry pointed out that the two sciences of biology and chemistry were developed during the nineteenth century independently of each other; tremendous advances have been made in more recent times as the two subjects have become closely interwoven into the science of biochemistry.

Since the end of the last century, organic chemistry has developed along two main lines: (1) the synthesis of new substances of little direct relation to biological science, and (2) the isolation and identification of substances from 'vital' chemistry. Progress has been slow in the chemistry of the animal body, and the lag between chemical recognition and the assignment of a definite biological function to compounds isolated is well exemplified by the fact that although creatine was isolated from muscle in 1832, it was not until 1927 that a definite role in muscle metabolism was assigned to this substance.

The comparatively new science of bacteriology had its origin in the work of Louis Pasteur, an organic chemist whose interests developed along 'biochemical' lines until he eventually became a complete biologist.

The investigation of protein chemistry by Sir Frederick Gowland Hopkins which led to his attempt to make a 'perfect' diet by mixing the correct amounts of fats, carbohydrates and proteins gave rise to one of the most sensational discoveries in recent years, the vitamins. In a very short time, many of these compounds have been not only isolated, but also in some cases have been assigned a definite chemical formula which has been proved by synthesis.

Several enzyme actions have recently been investigated from a chemical point of view, and it seems extremely probable that enzyme and coenzyme phenomena will shortly be explained as chemical actions, closely connected in some cases with the vitamins.

The discovery of the natural stimulants formed by the animal body, the hormones, has opened up an important new field of biochemical research, in which great advances have already been made. Several of these compounds have been isolated and synthesized, such as, for example, thyroxin and adrenaline, and the sex hormones have been shown by synthesis to be closely connected with inert sterols present in animal tissues.

Finally, even the transmission of nerve 'messages' has been shown to involve reversible physicochemical changes in which simple organic compounds play a part.

Pre-Roman Provence

EARLY in April of this year, it was announced that archæological discoveries, which are of no little importance, had been made near Saint-Rémy, a small town a few miles from Arles in Provence. Provence, the original 'Provincia' of Rome's extra-Italian expansion, is rich in monuments, which, if Roman in origin, are none the less Greek in spirit and conception. This is a legacy from the Greek colonists from Phocaea, who founded Marseilles about 600 B.C. and extended their influence over the whole region, which was later to be known as "The Province". Intermarriage with the natives left an indelible mark on the physique of the population, more especially to be seen in the beauty of the Provençal women.

Although the district around Arles was termed "Grecia" until the fourteenth century, little is known that is of purely Greek culture, nor has it been determined with precision how far and to what degree Greek influence pervaded the country. The importance

of the results of recent excavations lies in the fact that they have brought to light remains belonging to the pre-Roman period, as well as evidence pointing to the measure of fusion with native culture.

At Saint-Rémy, which possesses two theatres of the Roman period, both Greek and Roman constructions beside a tile-covered canal have been found near a Roman road, triumphal arch and tomb dating from the first century, and beneath a Roman wall. Fifty-two altars of local stone and marble were dedicated to either the god Sylvanus or the goddess Cybele. The foundations of an entirely Greek house were uncovered, in which twelve rooms are seen to have opened into an *atrium*, in which the bases of four columns are still visible. Baths of the time of Augustus, measuring forty-seven yards by thirty-five yards, were found. Into these, water flowed through a huge sculptured head. A large amount of Greek red-on-black pottery was found with forty-four small votive lamps and a magnificent rock crystal ring, ornamented with a woman's head.

Further discoveries in these excavations are now announced. According to a dispatch from the Paris correspondent of *The Times* in the issue of May 23, while most of the walls which have been found belong to a large Roman construction, the architectural remains of pre-Roman date are also important. A pillar with egg and astragalus pattern is of second-century Greek style, while column heads, probably pointing to Italian models, are evidently the work of competent masons of Greek training. The gargoyles, however, are the rustic Celtic versions of classical gargoyle lions. It is thought that they belong to a building, possibly a temple, of Greco-Celtic style.

Further evidence of cultural fusion comes from Glanom, a small Celtic *oppidum* near Saint-Rémy, where in a large necropolis graves containing Celtic and local Hellenistic pottery have been excavated by M. de Brun, keeper of the local museum. The tombs, it is stated, are marked by tall pillars, on which Celtic names are inscribed in Greek character. The cemetery is dated in the period of the Roman occupation at the end of the second century B.C. Still earlier evidence comes from Roquepertuse, where the Count de Gerin-Ricard, keeper of the Musée Borely at Marseilles, has excavated a sanctuary of the fourth century B.C. Here he has found what is described as a curious mixture of native and Greek taste. The pillars supporting the entablature are decorated with the heads of slain enemies, the horses on the frieze are of the barbarian type, while the double heads affixed to the architrave are a successful and attractive blend of Celtic and Greek elements.

Antarctic Plankton*

EXACT systematic work is essential for oceanographical plankton studies, since we must know the species with which we are dealing before we can use them in any practical way. Mr. Hendey's extensive monograph on the diatoms of the Southern Ocean is most useful and is a careful study entailing a large amount of labour. With so much material it has been possible to review the inside variation present in most groups and in the individual species. The interesting fact is clearly brought out, agreeing with Wimpenny (1936) that the diatom frustules in cold water are smaller, thicker-walled and more vigorous than those from warmer waters, the reverse of what is known to exist in many marine animals. The holoplanktonic flora of the cold water from the oceanic habitats forms the major part of the collection and consists of a small number of discoid and a large number of filamentous pennate forms. The author, however, in his classification discards the usual division into Centricæ and Pennatæ, and his method of regarding many so-called species and varieties as "phases" of one species reduces considerably the number of species recognized. Thus, to take one example, *Corethron* according to Hendley is a monotypic genus, *Corethron criophilium*, much discussed by many workers, being the only species with many phases. This at least tends to simplify matters, and a reduction of the ever-increasing number of species is all to the good.

Most of the diatoms of the Southern Ocean have a wide distribution and can tolerate a great variation in the conditions of their environment, but it is found that *Rhizosolenia curvata* Zacharias has a very limited range, being a typical sub-antarctic species occasionally spreading into Antarctic waters. Dr. Hart in his paper on this diatom shows that it forms a valuable indicator of the southern limit of sub-antarctic surface water. It has always been recognized that this surface water is frequently forced some small distance south of its normal limit, the Antarctic Convergence, and it has been possible to prove that *R. curvata*, an easily recognizable and characteristic form, is always in the plankton whenever it has been possible to show such southward movement hydrographically.

The seasonal circulation of the Antarctic macroplankton is dealt with by Dr. Mackintosh. Amongst other interesting facts it is shown that certain species which are usually regarded as inhabitants of the surface layers make an annual vertical migration into deep water in winter, and this migration by which they move from one current system to another is probably the means by which they keep within their normal geographical boundaries. The three species which in places make up the bulk of the Antarctic macroplankton, *Rhincalanus gigas*, *Eukrohnia hamata* and *Calanus acutus*, are mainly concentrated in the surface water in summer but descend into very deep water in winter. Since part of the Antarctic surface water moves in a northerly direction and there is a compensating southerly movement of the warm deep water, this vertical migration almost certainly results in the return of the species to the regions from which it originally came. The circulation is on a very large scale, the vertical range being from four to six hundred metres and the horizontal range being presumably some hundreds of miles.

* Discovery Reports. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Vol. 16. Pp. 151–364+plates 6–13. The Plankton Diatoms of the Southern Seas. By N. Ingram Hendey. 33*s.* net. Vol. 16. Pp. 365–412. The Seasonal Circulation of the Antarctic Macroplankton. By N. A. Mackintosh. 6*s.* net. Vol. 16. Pp. 413–446+plate 14. *Rhizosolenia curvata* Zacharias. By Dr. T. John Hart. 5*s.* net. (Cambridge: University Press, 1937.)

Science News a Century Ago

South African Exhibits

In 1837, Smith Elder and Co. published "A Catalogue of the South African Museum now exhibiting in the Egyptian Hall, Piccadilly", the property of a society entitled "The Cape of Good Hope Association for Exploring Central Africa". The Association had been formed in Cape Town on June 5, 1833, and its object was the acquisition of knowledge relative to the geography, natural history and commercial resources of the interior, and of the social condition of its inhabitants. £537 were subscribed within a few days, and an expedition left Graff-Reynet in June 1834. The zoological and ethnographical exhibits were one of the sights of London, and were afterwards sold by auction by Messrs. J. C. and S. Stevens on June 6–8, 1838, in pursuance of a resolution passed by the Association, over which Sir John Herschel occasionally presided. The sale included a number of models of Kaffirs and specimens of the arts and manufactures of the Bechuanas, zoological specimens and a geological collection.

Geographical Society of Berlin

Under its foreign correspondence, the *Athenæum* of June 9, 1838, said: "The Geographical Society of Berlin held an extra meeting last month to welcome the former President, Prof. Charles Ritter, on his return from the scientific tour which he had made in Greece and the Levant. Prof. Lichtenstein, the actual President, expressed on the part of the Society great satisfaction in their renewed connexion with one who had done so much to advance the science of Geography. Prof. Ritter then gave a hasty sketch of the interesting observations which he had made in Greece and the Ionian Islands, in European and Asiatic Turkey and in Maldavia and Wallachia."

Karl Ritter, who was once described as "the greatest geographer of modern times", was born at Quedlinburg on August 7, 1778, and at nineteen years of age became a tutor in the family of Bethmann-Hollweg at Frankfort-on-Main. With his pupils he travelled through Switzerland, Savoy, France and Italy, and studied at Göttingen. In 1819 he was called to the gymnasium at Frankfort as professor of history, but the next year was made an extraordinary professor of geography in the University of Berlin. The great work, "Die Erdkunde im Verhältniss zur Natur und zur Geschichte des Menschen", which had established his reputation, had appeared in two volumes in 1817–18. He died on September 28, 1859, at the age of eighty years.

Zusseh Silkworms of India

At a meeting of the Asiatic Society on June 9, 1838, Dr. Geddes read a paper "On the Zusseh Silkworms of India". The moth of the Zusseh silkworm, he said, was the *Saturnia paphia*. The moth had been twice caught while depositing her eggs by Dr. Geddes—once in December 1826 and again in November 1830. The eggs deposited after that were, in each case, above 200; they were in small heaps, adhering together, and generally hatched in a little more than ten days. The interval between hatching and spinning was different in different larvæ from the same moth, being in some cases as long as 36 days and in others as much as 50. When fully grown, the larva is about 4 inches long, its head is light brown, its body green with rows of spots, orange, red and blue. Dr. Geddes fed them upon the leaves of the Ber tree (*Zizyphus jujubus*) but he had also seen them on the Ahseen (*Terminalia alata glabra*) on which the insect is fed in the Nagpore territories. The natives place them on the tree when hatched; and as soon as the leaves are devoured, they chop off the branches, and place them, insects and all, upon another tree. When ready to spin, the insect first forms a thick ligature of an inch in length which it fastens to a twig, and at the extremity it spins its cocoon, which sometimes reaches the size of a pigeon's egg.

The Actonian Prize

Early in 1838 the Royal Institution received a donation of one thousand pounds from Mrs. Hannah Acton. The gift, which was made out of respect and regard for the memory of her late husband, Mr. Samuel Acton, architect, was to form an endowment fund, and the trust established, which the Managers of the Royal Institution undertook, was to award a prize of one hundred guineas, once every seven years, to the person who should be "the Author of the best Essay illustrative of the Wisdom and Beneficence of the Almighty in such department of Science as the said Committee of Managers for the time being of the said Institution shall in their discretion select". In June 1838 the conditions governing the award of the Actonian Prize were made known. The first award was to be made in 1844, and the subject was to be chemistry. In due course the prize of 1844 was given to George Fownes for his essay on chemistry. Every seven years since, in accordance with Mrs. Acton's pious intention, the prize has been awarded. The list of the recipients contains many distinguished names, including those of Sir George Stokes, Sir William Huggins, Madame Curie, Sir Charles Sherrington, Dr. George Ellery Hale and Prof. A. V. Hill. The prize was last given in 1935 to W. T. Astbury, for his paper on "X-Ray Studies of the Structures of Hair, Wool and Related Fibres".

Ornithological Society

The *Gentleman's Magazine* for June 1838 contains the following account of the anniversary meeting of this Society held on May 18 with Mr. M. W. Colbourne in the chair. The Council in its report congratulated the members on the position which the Society had already obtained. The number of its members was stated to be 205, a number probably unprecedented in the first year of any other scientific society. Reference was then made to the great injury which the collection in St. James's Park at first sustained from the children and other frequenters of the Park; but the Council now had the pleasure of reporting that a marked improvement in this respect might be observed. Little more than a nucleus of the Museum and Library has as yet been formed, but the Council expressed a confident hope that with the valuable services of the curator, Mr. Blyth, a sufficiency of illustrations for the monthly lectures will be very shortly obtained. The accounts of the Society for the last year had been audited, and the balance in hand was £11 16s. The sums then owing by the Society were £36 17s. 9d. and the sums owing to the Society were £42.

University Events

CAMBRIDGE.—M. Black, of Trinity College, has been appointed University lecturer in geology, and W. W. Williams, of Fitzwilliam House, University lecturer in geography.

C. Culpin, of St. John's College, has been appointed University demonstrator in agricultural engineering.

Candidates for the Michael Foster studentship in physiology are requested to send their applications, with a statement of the course of research they propose to undertake, to Prof. E. D. Adrian, Physiological Laboratory, by July 7. The student receives the annual value of the fund (about £100), and may be re-elected for a second year.

Approval is sought for the plans prepared by Mr. C. Holden for the Austin Wing of the Cavendish Laboratory, and for the plans prepared by Mr. J. Murray Easton for an extension to the Psychological Laboratory.

The General Board recommends that a readership in medicine be established for one tenure only, and that the General Board be authorized to appoint Dr. McCance, at present assistant physician in charge of the Biochemical Department at King's College Hospital, London, to this post from August 1, 1938, with a pensionable stipend of £850.

The following have been approved for the degree of Sc.D.: Prof. J. F. Baker of Clare College, professor of civil engineering in the University of Bristol; C. Forster-Cooper of Trinity Hall, director of the British Museum (Natural History); and Dr. E. C. Stoner of Emmanuel College, reader in physics in the University of Leeds.

GLASGOW.—The University has decided to confer the honorary degree of LL.D. on the following, among others, at the Commemoration Meeting on June 22: Prof. W. J. Jongmans, professor of palæobotany in the University of Groningen; Prof. Max Planck, professor of theoretical physics in the University of Berlin; Prof. M. J. Stewart, professor of pathology in the University of Leeds; Prof. C. T. R. Wilson, emeritus professor of natural philosophy in the University of Cambridge; and Prof. G. G. Henderson, emeritus professor of chemistry in the University of Glasgow.

OXFORD.—Prof. J. H. Muirhead, emeritus professor of philosophy, University of Birmingham, has been appointed Herbert Spencer lecturer for 1939. His subject will be "The Man versus the State as a Present Issue".

R. H. S. Thompson, Trinity College, has been elected to a fellowship and praelectorship in medical science at University College.

In Congregation on May 24 it was announced that the Minister of Agriculture and Fisheries has appointed Lord Fleming, Sir Henry Bunbury, and Mr. Lawrence Holt to advise him on the representations of the University that part of the sum of £75,000, the cost of settling the action between the University and Sugar Beet and Crop Driers Ltd., should be borne by public funds.

READING.—Mr. E. Capstick has been appointed to the newly instituted professorship of dairying as from September 30.

Societies and Academies

Paris

Academy of Sciences, April 4 (*C.R.*, 206, 1065–1151).

PIERRE LEJAY: Variations in the amount of moisture contained in the air in the neighbourhood of Shanghai.

CLAUDE CHABAUTY and CHARLES PISOT: An algorithm for the simultaneous approximation of two real numbers.

MENDEL HAIMOVICI: The geometry of an integral.

ARNAUD DENJOY: The singularities of analytical functions of functions defined by an element.

ARMAND RAUCH: Integral functions of the class of divergence of positive order ρ.

CHARLES BLANC: A decomposition of the problem of the type of Riemann surfaces.

HENRI MILLOUX: Holomorph functions and their derivatives in the circle unity.

ADRIEN FOCH, ANDRÉ FORTIER and JEAN FIVET: The correction at the entrance of a cylindrical tube traversed by a gaseous current.

VICTOR VOLKOVISKY: The transport of ions in a fluid moving with a supersonic velocity.

DAMODAR D. KOSAMBI: Homogeneous metrics in cosmogonic spaces.

HENRI GROUILLER: The determination of the curves of blackening in astronomical photographic photometry.

PIERRE LACROUTE: Variations in the spectrum of *P* Cygni.

GEORGES DURAND: Orbit of the visual double star $O\Sigma$ 77 and the mass-luminosity relation.

JEAN LOUIS DESTOUCHES: Remarks on the heavy electron.

GEORGES FOURNIER: Geometrical structure of space and electronic atmospheres.

MAX GELOSO and PIERRE DESCHAMPS: Researches on the mechanism of the electrolytic deposit of copper in the presence of iron salts.

MME. H. EMMANUEL-ZAVIZZIANO and H. HAÏSSINSKY: Electrolysis of solutions of protactinium. Starting with titanium solutions containing actinium, a concentration of the latter can be obtained under suitable conditions of electrolysis.

MLLE. LUCIENNE CHAUMETON: Magnetic study of the dehydration of crystallized copper hydroxide.

PIERRE ROUARD: Some optical properties of very thin sheets of platinum.

MLLE. MARIE LOUISE DELWAULLE, FÉLIX FRANÇOIS and JOSEPH WIEMANN: Application of the Raman effect to the study of the complex compounds existing in solutions containing mercuric bromide and an alkaline bromide.

BERTRAND GOLDSCHMIDT: The mixed precipitation of the sulphates of barium and strontium.

JEAN AMIEL: Paramagnetism of the organic cupritetrachlorides and cupritrichlorides.

GUY EMSCHWILLER and GASTON CHARLOT: Solubility of calcium carbonate in solutions of ammonium salts. The increase in the solubility of calcium carbonate in the presence of ammonium salts is mainly due to phenomena of hydrolysis and only to a minor extent to the action of the salt.

ANDRÉ BOROCCO: Dissociation pressure of rubidium and cæsium hydrides and deuterides. The dissociation pressures of rubidium and cæsium deuterides are greater than those of the corresponding hydrides.

GUY COGNÉ: Zinc peroxide. The peroxide $ZnO_2.0{\cdot}5\ H_2O$, not hitherto isolated, has been prepared. From its reactions, it would appear to be a true peroxide, and not a compound of zinc oxide and hydrogen peroxide.

RAYMOND DELABY and JEAN HUBERT: Bromine index of the ethylenic nitriles.

URBANSKI: Nitration of phenylnitromethane. Dinitrophenylnitromethane can be prepared by the intensive nitration of phenylnitromethane: it was shown to have the 1.3.5 constitution.

MARCEL TUOT: Secondary reactions observed in the course of organo-magnesium condensation of the esters in the fatty series.

ANDRÉ GUILLEMONAT: Oxidation of some substituted cyclohexenes by selenious anhydride.

GILBERT MATHIEU: Recent deformations of the soil in the north-west of La Vendée and the reason for the existence of the Island of Yeu.

GÉRARD WATERLOT: Structure and origin of the Poitevin marshland.

JACQUES FLANDRIN: Main structural lines of the Djurdjura (Algeria).

FRANTIŠEK LINK: Twilight phenomena visible during total eclipses of the sun.

RENÉ BERNARD: Variations of intensity of the sodium *D* line present in the spectrum of the light of the sky at twilight. Discussion of the results obtained by Currie and Edwards in Canada, in the course of the International Polar Year 1932–33, with special reference to the observation of the *D* line of sodium in the atmosphere.

GÉRARD GAZET DU CHATELIER: Structure of the androecium of the Sterculiaceæ.

WILLIAM HENRI SCHOPFER and SAMUEL BLUMER: Growth factors of species of the genus *Ustilago*.

CONSTANTIN DAWYDOFF: Two remarkable cœloplanids of Indo-Chinese waters.

ANTOINE JULLIEN and DANIEL VINCENT: The esters of choline in some organs of molluscs.

PAUL MEUNIER and YVES RAOUL: A vitamins and carotenoids. The kinetic study of the Carr-Price reaction. The rapid fading of colour in the Carr and Price reaction in the presence of acetic anhydride is characteristic of vitamin A_1 provided that the medium is free from unsaturated fatty acids.

MAURICE DOLADILHE: Anaphylactic properties of hæmolysin.

ERRATUM.—MAURICE HENRY PIREENE: The diffraction of X-rays by silicochloroform. The summary of this paper in NATURE of April 16, p. 702, should read: "The valency angle is within two or three degrees of the angle of a regular tetrahedron. A plane structure of the $SiCl_2$ group, such as has been proposed by G. Urbain, is inadmissible."

Cracow

Polish Academy of Science and Letters, March 7.

T. BANACHIEWICZ: A new aspect of quaternions.

W. NOWATKE: Molecular dimensions of organic compounds and the constant of dialysis of their solutions. The author has shown that there is a direct relation ($\delta\sqrt{n}$ = constant) between the dialysis constant (δ) and the number of atoms in the molecule (n) and also between the dialysis constant and the radius (r) of the molecule ($\delta.r$ = constant).

J. WALAS: The migrations of alpine plants along the water-courses of the massif of the Tatras.

MME. M. SKALINSKA: Cytogenetic researches on the aneuploid *Aquilegia*.

J. HANS and MLLE. Z. TABENCKA: The blood vessels in the skin of *Myxine glutinosa*.

H. SZARSKI: The subdermal corpus lymphaticum in the frogs *Rana esculenta*, *R. temporaria* and *R. terrestris*.

Z. GRODZINSKI and J. MARCHLEWSKI: The action of serum on the mobility of the spermatozoids of the cock.

L. MONNÉ: The vital polychrome colorations of the different cells of gasteropods with the aid of pyronines.

ZB. GLOWCZYNSKI: The proportion of vitamin A in the seed of canary grass, *Phalaris canariensis*.

MLLE. R. SKROCHOWSKA: Acquired habits in their relations with the repeated action of stimuli in *Vorticella*.

Rome

National Academy of the Lincei (*Atti*, 26, 193–251; 1937).

F. ENRIQUES: Curves infinitely close together on an algebraic surface.

B. LEVI: A property of the system of the nth partial derivatives of a function of more variables.

U. CISOTTI: Mechanics of disperse continuous media.

G. ARMELLINI: Fundamental problems of cosmogony and Newton's law (1).

C. AGOSTINELLI: Integration of the differential equation

$$\frac{\delta^2 u}{dx^2} + \frac{\delta^2 u}{\delta y^2} + \frac{\delta^2 u}{\delta z^2} - \frac{1}{x}\frac{\delta u}{\delta x} = f,$$

and a problem analogous to that of Dirichlet for a hemispherical field (2).

M. SCHÖNBERG: A class of functional equations.

A. COLACEVICH: Spectroscopic and spectrophotometric observations of the comet Finsler (1937 *f*).

A. IANDELLI and E. BOTTI: Crystal structure of the compounds of the rare earths with metalloids of the fifth group (5). 1 : 1 compounds with bismuth.

E. MARIOTTI: Modification of van Slyke's method for the analysis of proteins.

L. MASCARELLI and M. PIRONA: Contribution to the knowledge of diphenyl and of its derivatives (19). Preparation of some new derivatives.

C. PERRIER and A. BELLANCA: The use of the potentiometer for the determination of time temperature curves in thermal analyses.

Atti, 26, 253–303; 1937.

G. FUBINI: Asymptotic studies for some differential equations.

C. MINEO: Impossibility of a stratification of homotectic equilibrium for rotating fluid stars.

R. WOINAROSKY: Kinematics of a solid body in ordinary space of three dimensions.

G. L. ANDRISSI: Observations of the comet 1936 *a* (Peltier).

L. GIALANELLA: Meridian observations of Jupiter, Saturn, Uranus and of the moon in 1936.

G. WATAGHIN: Theory of elementary particles (1). A system of gravitational equations of the first order (2).

A. CAVINATO: Observations concerning the note of S. Vardabasso "Contribution to the knowledge of the recent volcanism in Sardinia".

L. MASCARELLI and B. LONGO: Contribution to the knowledge of diphenyl and of its derivatives (20). A new example of the change from the diphenyl to the fluorene system: synthesis of 3-methylfluorene.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, June 7

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. B. P. Babkin: "The Physiology of the Digestive Glands" (succeeding lecture on June 9).*

ST. MARY'S HOSPITAL (INSTITUTE OF PATHOLOGY), LONDON, at 5.—Sir Henry Dale, F.R.S.: "Chemical Agents transmitting Nervous Excitation".

Thursday, June 9

RESEARCH DEFENCE SOCIETY (at the London School of Hygiene, Keppel Street, W.C.1), at 3.—Annual General Meeting.

Prof. C. H. Best: "Insulin and Diabetes: The Present Position" (Stephen Paget Memorial Lecture).

CHELSEA PHYSIC GARDEN, at 5.—Prof. E. J. Salisbury, F.R.S.: "Plants in Relation to the Human Environment" (Chadwick Public Lecture)*.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, June 6–11. Conference on "Oil Shale and Cannel Coal" to be held at Glasgow.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN CHEMISTRY in the Battersea Polytechnic, London, S.W.11—The Principal (June 9).

LECTURER IN PHARMACEUTICS in the Leicester College of Technology and Commerce—The Registrar (June 13).

LECTURER IN PHYSICS AND MATHEMATICS in the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3 (June 15).

ASSISTANT LECTURER IN MATHEMATICS AND ASSISTANT LECTURER IN ECONOMICS in University College, Swansea—The Registrar (June 17).

ASSISTANT LECTURER IN CHEMISTRY in the University of Sheffield—The Registrar (June 18).

EXAMINER in the Standards Department of the Board of Trade—The Assistant Secretary, Establishment Department, Board of Trade, Great George Street, S.W.1 (June 18).

PROFESSOR OF PATHOLOGY and LECTURER IN PATHOLOGY in the University of Bristol—The Registrar (June 20).

ASSISTANT LECTURERS IN ORGANIC CHEMISTRY AND IN GEOLOGY in the University of Bristol—The Secretary (June 21).

PROFESSOR OF VETERINARY PHYSIOLOGY in the Royal Veterinary College, Camden Town, London, N.W.1—The Bursar (June 30).

ASSISTANT IN RESEARCH IN RADIOLOGY, ASSISTANT IN RESEARCH IN PSYCHIATRY and ASSISTANT IN RESEARCH IN PATHOLOGY in the University of Cambridge—Mr. R. Williamson, Department of Pathology, Tennis Court Road, Cambridge (July 1).

TECHNICAL OFFICER in the Meteorological Office—The Secretary (S.2.a), Air Ministry, Adastral House, Kingsway, London, W.C.2 (July 2).

WOMEN EXAMINERS and AN EXAMINER in the A.I.D. Test House, Kidbrooke, S.E.3—(The Secretary, Air Ministry (I.G.), Kingsway, London, W.C.2.

TECHNICAL OFFICER at the East Malling Research Station, near Maidstone, Kent—The Secretary.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Annals of the Solar Physics Observatory, Cambridge. Vol. 5, Part 1: The Spectrum of *Fe II*. By Dr. J. C. Dobbie. Pp. v+59+2 plates. (Cambridge: At the University Press.) 7*s.* 6*d.* net. [55

Annual Reports on the Progress of Chemistry for 1937. Vol. 34. (Issued by the Chemical Society.) Pp. xvi+540. (London: Chemical Society.) 13*s.* [95

Thirtieth Annual Report to His Majesty the King of the Governing Body of the Imperial College of Science and Technology, South Kensington. Pp. 136. (London: H.M. Stationery Office.) 2*s.* net. [125

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year ended 30th June 1937, with Report of the Director of Water Pollution Research. Pp. iii+45. (London: H.M. Stationery Office.) 9*d.* net. [135

British Museum (Natural History). Summary Guide to the Exhibition Galleries. Fifth edition. Pp. 16. (London: British Museum (Natural History).) 2*d.* [135

British Museum (Natural History). John Murray Expedition, 1933–34. Scientific Reports, Vol. 5, No. 4: A Systematic and Anatomical Account of the Opisthobranchia. By Dr. N. B. Eales. Pp. 77–122+1 plate. (London: British Museum (Natural History).) 5*s.* [135

University of London. Report of the Principal on the Work of the University during the Year 1937–38. Pp. 13. (London: University of London.) [135

The Animal Year Book. Vol. 5. Edited by Dr. H. E. Bargmann. Pp. vi+178+7 plates. (London: University of London Animal Welfare Society.) 2*s.* 6*d.* [135

Ministry of Health and Scottish Office. The Surface Water Year-Book of Great Britain, 1935–36: being a Statistical Report relating to the Inland Surface Water Resources of Great Britain during the twelve months ended 30th September 1936. Prepared under the Direction of the Inland Water Survey Committee. Pp. 112. (London: H.M. Stationery Office.) 5*s.* net. [165

Patents, Designs and Trade Marks: Fifty-fifth Report of the Comptroller-General of Patents, Designs and Trade Marks, with Appendices, for the Year 1937. Pp. 25. (London: H.M. Stationery Office.) 6*d.* net. [165

Royal Society for the Protection of Birds. Forty-seventh Annual Report, January 1st to December 31st, 1937, with Proceedings of Annual Meeting, 1938. Pp. 125. (London: Royal Society for the Protection of Birds.) 1*s.* [165

Scottish Education Department. Report on the Royal Scottish Museum, Edinburgh, for the Year 1937. Pp. 24. (Edinburgh and London: H.M. Stationery Office.) 3*d.* net. [175

Amguedefa Genedlaethol Cymru (National Museum of Wales). Studies in the Origin of the Scenery of Wales: 1: The River Scenery at the Head of the Vale of Neath. By Dr. F. J. North. Pp. iv+60+20 plates. (Cardiff: National Museum of Wales.) 1*s.* 6*d.* [175

Other Countries

Publications of the Observatory of the University of Michigan. Vol. 7, No. 2: A Spectrographic Study of B. Scuti. By Dean B. McLaughlin. Pp. 57–78+1 plate. (Ann Arbor: University of Michigan Observatory.) [95

Brooklyn Botanic Garden Record. Vol. 27, No. 2: Containing the Twenty-seventh Annual Report of the Brooklyn Botanic Garden, 1937. Pp. 149. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [105

Skrifter utgitt av det Norske Videnskaps-Akademi i Oslo. 1937, No. 7: Two Land-locked Fjords in Northern Norway. By Kaare Münster Strøm. Pp. 12. 1.50 kr. 1937, No. 8: Eikesdalsvatn; a Limnological Reconnaissance. By Kaare Münster Strøm. Pp. 11. 1.25 kr. 1938, No. 1: Moskenesøy; a Study in High Latitude Cirque Lakes. By Kaare Münster Strøm. Pp. 32+4 plates. 4 kr. (Oslo: Jacob Dybwad.) [95

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